MACHINERY.

Vol. 7. February, 1901. No. 6.

AMONG THE SHOPS.

WORCESTER, MASS., WILMINGTON, DEL., AND PROVIDENCE, R. I., ARE REPRESENTED IN THESE NOTES.

CUTTING THE WORMWHEEL ON A WARREN RADIAL DRILL ARM.

The accompanying half-tones show the method pursued in the shop of the W. H. Warren Machine Tool Works, Worcester, Mass., for cutting the wormwheel on the end of the radial arm for their radial drills. The wormwheel, which is an integral part of the arm, has a worm engaged with it for turning the arm on its horizontal axis.

The business of this company, which many will learn with regret is to be transferred to Germany, has always been conducted on very conservative lines, which necessitated the development of several ingenious makeshift devices for handling work. That these makeshift devices enabled the production of a superior machine, however, nearly all will agree who are familiar with these excellent radial drills.

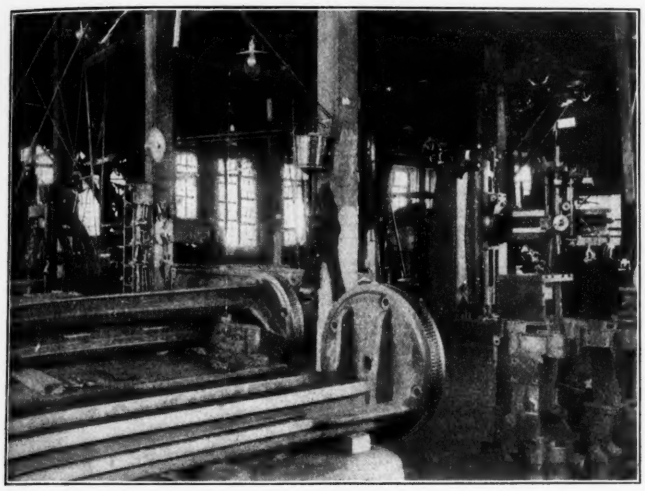


Fig. 1. Radial Arm of Warren Drill after being Hobbed.

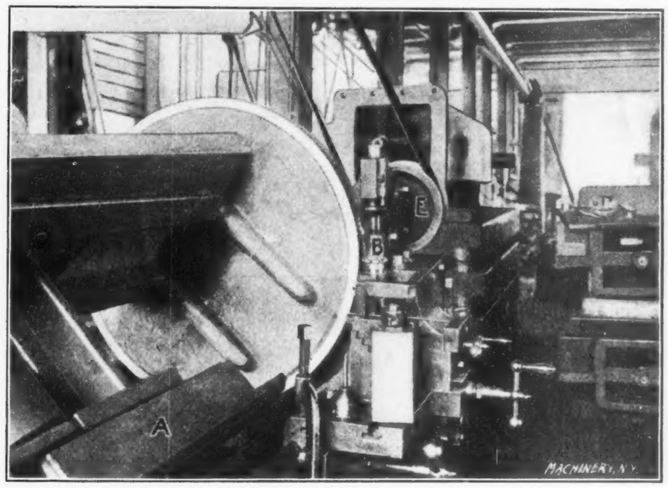


Fig. 2. Gashing the Worm Wheel.

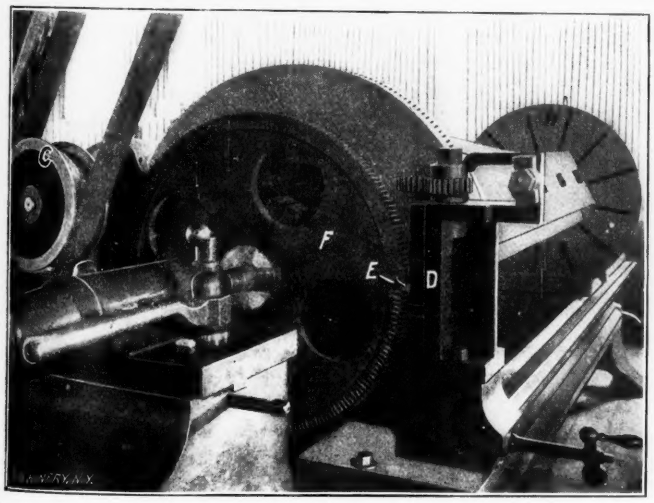


Fig. 3. Index Mechanism.

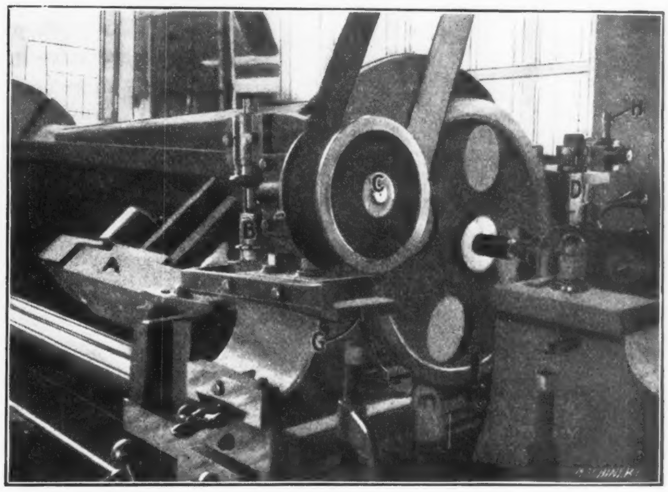


Fig. 4. Showing the Wedge G for Inclining the Gashing Cutter.

Fig. 1 shows in the foreground the piece to be hobbed. It is the radial arm and is necessarily a rather heavy and awkward piece to handle on any machine, and perhaps is better handled in a lathe than elsewhere. Mr. Warren devised the scheme shown for accomplishing the hobbing. The cuts show the preliminary gashing being done with a cutter for forming gear teeth. The radial arm is held upon the centers of the lathe and is counterweighted at A, Fig. 2, to make it more or less in balance. This makes it possible to turn it by hand upon dead centers. The hobbing rig is clamped upon two tool post slides, one in front and one at the rear of the lathe. It consists at the front of a vertical cutter arbor, B, driven through miter gears by a horizontal shaft and pulley E. At the rear a casting D carries a vertical shaft and gearing, and a stop pin E. F is an index wheel clamped firmly to the casting to be hobbed. In gashing the casting the cutter is set to the proper angle by the wedge G. The cutter is fed into the work by the cross feed handle and screw. It is then set for another tooth, by a helper at the rear, by turning it until the index pin E, Fig. 3, drops into the next space in the index plate. The helper keeps his record, it will be noted, by the use of chalk marks upon the index plate.

After the gashing is completed the cutter is replaced by a regular hob and the index plate is removed. The hob is fed into the wheel as usual and revolves the wheel while cutting the teeth, as in a milling machine. To insure its moving steadily the workman assists it by hand. The circumference is then graduated adjacent to the teeth. To accomplish this the cutter

rig is removed from the front tool post and a pointed tool clamped in its place. The index plate is replaced by a worm wheel and the index pin by a worm that meshes with it. The wheel is thus fitted to be revolved by the handle H, Fig. 4, which revolves the gears and through them the worm shaft. Any desired part of a revolution can thus be obtained, the markings being made with the pointed tool. In this manner a difficult job is done very neatly and accurately with a comparatively inexpensive rig.

WORK AT THE BETTS MACHINE COMPANY.

A recent call at the shops of the Betts Machine Company, Wilmington, Del., found them busily employed on heavy tools, part of which are for the new machine shops of the Brooklyn Navy Yard. The company, at present, confine their business entirely to the manufacture of planers, slotters, horizontal boring machines and boring and turning mills. The latter are now being made with the table driven by a spur pinion meshing in an internal toothed gear and also by a worm and worm-wheel. The latter form of drive has been found generally satisfactory and will probably be adopted as the standard form of construction in the near future.

The erecting shop is a comparatively new structure about 250 feet long and served by two traveling cranes of ten and fifteen tons nominal rating. The character of the present work is such that the nominal power of the cranes is daily required and often more. A ten-foot planer, driven by an electric motor, is kept running night and day doing work, most of which requires its full capacity. It has been so employed for months, stopping only Sundays. Even running so constantly, it has not been able to keep abreast of the work on hand and, as a result, a smaller planer has been partially dismantled and rigged as roughly outlined in the sketch, Fig. 5, for planing work larger than its nominal width.

The housing on the left side was taken down and set up on a spare planer platen D, as shown at C, and bolted fast. The platen D was carefully leveled and weighted down so as to be stable. A strut, H, was secured between the housing, C, and the end of the cross-rail to take the thrust of the cut. Another spare platen, E, had been laid down beside the planer and weighted the same as D. On this platen was bolted the housing, F, carrying the cutting tools.

At the time of the writer's visit, a large planer housing was on the planer, having the top machined as indicated in the diagram at B. In this case the housing, C, would not have interfered if it had been in its normal position, but with wide long work, its indicated position was, of course, necessary.

An English screw-cutting lathe, about 24" x 16', made twenty or thirty years ago, by Joseph Whitworth, Manchester, was noticed in the machine department. The history of its purchase is somewhat interesting, in the light of modern conditions. The lathe was bought for cutting lead and feed screws and is said to be a most excellent tool for this purpose, the lead screw being yet quite accurate, even after its years of service. The screw is about 3" in diameter, and has a pitch of perhaps three threads per inch. The shape of thread is approximately the same as a square thread, but with rounded top similar to a knuckle thread. The screw is located inside of the flat top ways, a very good position for a central draft on the carriage, but unhandy for manipulation of the feed nut. The carriage is as awkward to handle as an English carriage can well be and, in consequence, it is not at all in favor with the machinists using it. The back gears are engaged by sliding them longitudinally on the shaft.

When the lathe was purchased, the company were required to deposit the purchase price, $2,000 in gold, with a Boston bank when the order was given, before Whitworth would consider it, which apparently was the general custom followed when filling foreign orders. Now many American shops, including the one in question, are supplying the machinery for machine shops in the Old World and are doing it on credit for sixty to ninety days' time, after the goods have been delivered. Sometimes this policy proves unwise, but it is quite evident that the former high-handed commercial policy of the English manufacturers is a thing of the past.

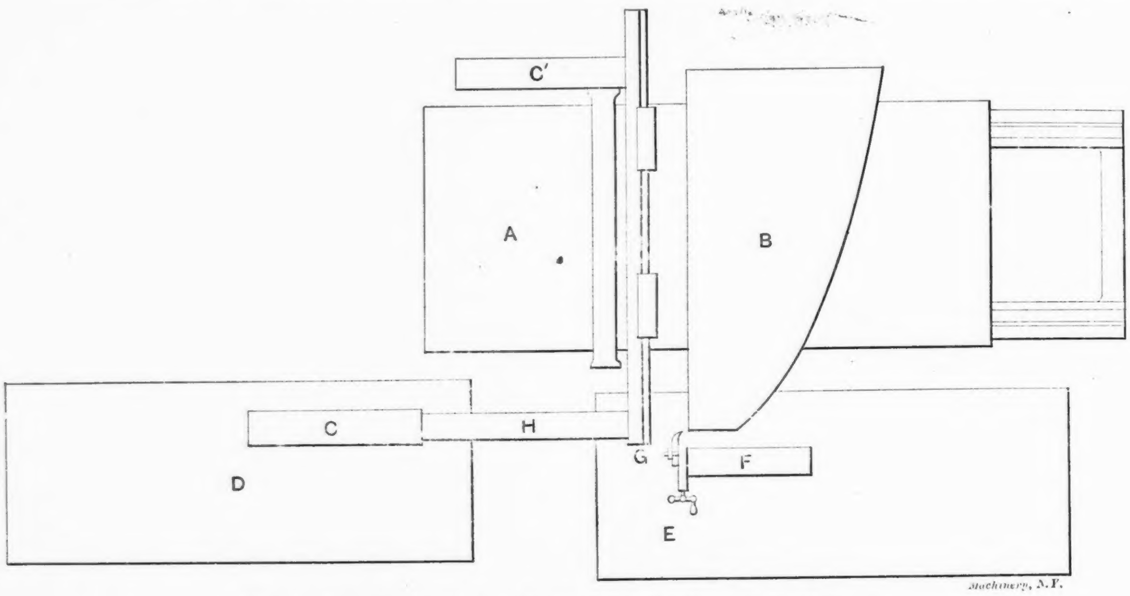


Fig. 5. Method of Machining a Large Planer Housing on a Small Planer.

PAPER CALENDER ROLL MAKING.

The roll grinding machine, invented something over thirty years ago by J. Morton Poole, Wilmington, Del., probably has been more widely described and commented on in the technical press and by mechanical engineers than any other invention of similar minor character. The reason for this has partly been because of the exceeding accuracy of the work done by it, but principally on account of the seeming paradox of design which enables the production of almost mathematically perfect cylinders with the grinding wheels suspended in a condition of non-restraint to transverse movement.

Fig. 6 is an end section of the Poole grinding machine which, in rough outline, shows the principle of operation. The hardened roll A, which has been carefully turned as accurately as possible, is mounted on V-blocks which support it at the bearings or "necks" instead of carrying it on centers as is the case with the ordinary grinding machine on small work. The grinding wheels, of corundum, F and F', are mounted on the swing frame E which is supported by the hangers B and B'. These hangers have knife-edge bearings which allow the frame and grinding wheels to oscillate transversely across the ways with the slightest impulse. The carriage D moves in V-ways similar to those of a planer bed. The grinding wheels are driven by duplicate belts, each arranged as shown and running from the upper drum C down to the left wheel F, then up to the drum C' and down to the right wheel F' and back to the upper drum. The duplicate belt is arranged in the same manner and runs on pulleys on the grinding wheel arbors, at the opposite ends from those shown, so that each wheel is driven from both ends of its arbor.

The carriage is driven back and forth by a screw whose direc-

tion of rotation is automatically reversed at any prescribed point of its travel as may be determined by the operator. The travel of the carriage is rapid as compared to the rate of rotation of the roll, giving a feed which ordinarily will be from three-fourths to one inch per rotation. When grinding hardened iron rolls, the work is flooded with soda water, but when grinding brass rolls generally no water is used. The grinding wheels are each held on a cross-slide with screw adjustment, not shown, the same as a lathe carriage, but the manner of adjustment is unique. The operator does not take hold of the handles and screw them against the rotating roll, but instead taps them lightly with a small wooden mallet having a slender handle about thirty inches long.

As the grinding proceeds, the two wheels on opposite sides act as sizing calipers to make the roll of uniform diameter and the inertia of the heavy swing frame E causes it to move in a line which is supposed not to deviate from absolute straightness over one ten-thousandth of an inch. This comes about partly from the tendency of a body to move in a straight line and partly

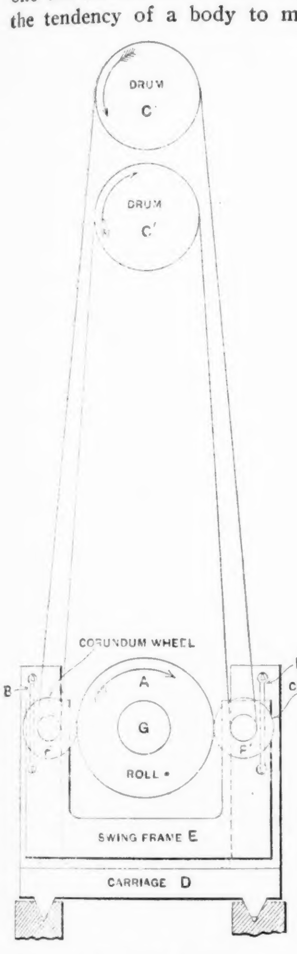


Fig. 6. Poole Machine.

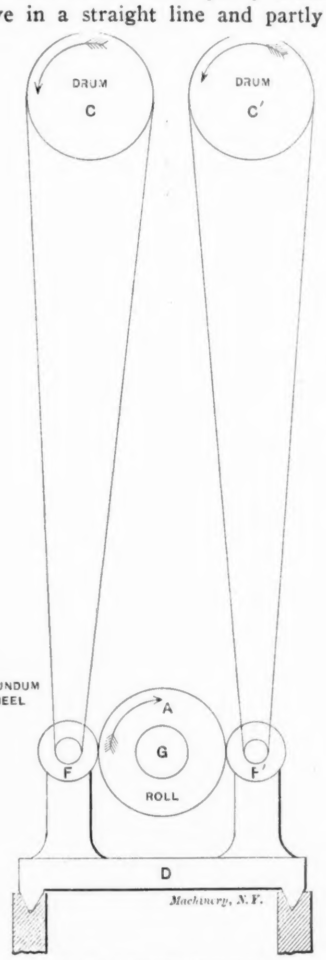


Fig. 7. Lobdell Machine.

from the tendency of the swing frame to follow the geometrical axis of the rotating roll which is a mathematically straight line and which, of course, is as nearly parallel to the ways as possible.

The invention of the Poole machine made a wonderful improvement in calender rolls and a great reduction in their cost, as the former processes for grinding them had been very crude. The methods formerly employed were guide grinding and finishing with lead or copper laps. In this manner rolls were obtained which were parallel but not perfectly straight, which condition was very necessary for the production of paper of uniform thickness. So much for the Poole machine, which certainly is enough, but which is not "the whole thing" in roll grinding, as some may learn with surprise.

For many years the Lobdell Carwheel Company, Wilmington, Del., have been grinding paper calender rolls and rolls for other purposes in machines which do not involve the Poole principle, but which give results practically as good, since the rolls pass the severe tests prescribed by the paper makers. The Lobdell machine is outlined in Fig. 7, which shows the grinding wheels F and F′ mounted directly on the carriage D which is guided in V-ways and driven back and forth by a screw for the feed. The grinding wheels are driven by double belts, one on each side of each wheel as with the Poole machine, but there are four belts in all, each pair driven by the independent drums C and C′, the reason for which will be given later. The roll being ground is supported on its necks in V-blocks, which are constantly well lubricated with heavy oil so as to prevent any heating of the bearings. If, by any chance, the bearings become heated, it is necessary to delay the finish grinding until the roll has cooled down, which may require half of a day or more. The V-ways for the carriage are a very sharp angle, being about that indicated in the cut. They are spread far enough apart so that the soda water used on the roll does not splash onto them and interfere with the lubrication. When "finish" grinding, no fresh oil is allowed to be put on the ways, as it has been found that the slight thickness of the fresh oil film is sufficient to affect the accuracy of the work.

When the roll has been ground with both wheels until it appears to be of uniform diameter throughout, as measured with a beam micrometer caliper, the "back" wheel as it is termed—being the one opposite to the side the operator ordinarily occupies—is removed from its bearings and a chilled iron wheel, mounted on an arbor which fits the grinding wheel bearings, substituted. The bearings of the grinding wheels are conical as indicated in Fig. 8, and the chilled wheel with its bearings is in form practically a duplicate of the grinding wheels.

The grinding is then resumed with the one wheel in position. The chilled iron wheel is not belted to its drum but rotates as a friction wheel driven by the roll. For this reason the belt arrangement of the Poole machine cannot be used. The chilled wheel is as accurate as it is possible to make it and its use is

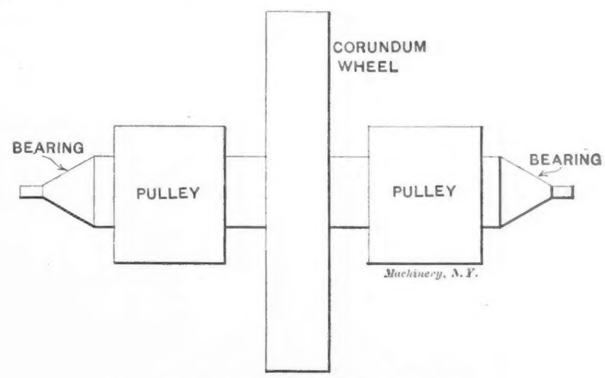


Fig. 8. Design of Grinding Wheel.

simply to act as a gage of accuracy. The roll is already as nearly accurate as it is possible for the operator to determine in the ordinary manner, but when the blank is adjusted so that it is driven by the rotating roll, a very interesting action may be seen. The blank wheel instead of turning at a uniform rate, turns intermittently, stopping and starting as the roll turns, which shows that the roll is not exactly concentric with the neck bearings. The grinding is continued until the blank wheel rotates continuously throughout the whole length of the roll, when it is considered perfect. That this arrangement is a most accurate gage of accuracy, there seems no doubt when the results are seen, but why it is so, is quite incomprehensible. It is fully as paradoxical in its action as the swinging frame of the Poole machine, and in fact, more so, since this is susceptible of a scientific explanation. In the case of the Lobdell machine, the blank wheel is held against the rotating roll with a certain degree of pressure which must be enough to cause it to turn when in contact with the high spots, but the difference in height of the high and low spots is only a fraction of a thousandth of an inch, so the natural inference would be that the elasticity of the cross-slide and bearings would be sufficient to follow up the roll and cause a continuous rotation of the blank wheel, but it is not.

A stack of calender rolls often contains ten or more rolls piled one on top of the other. Their length may be about eight feet each and the diameter of the bottom roll, say 18″. The intermediate rolls will have a diameter of perhaps 12″, and some of them will have provision for internal circulation of steam for drying the paper. The total weight of a stack of rolls may be as much as thirty thousand pounds and often more in the case of special machines. The bottom roll carries all of the weight of the rolls above it, including the pressure of the screws on the top roll. As

a consequence, the bottom roll is slightly deflected by the weight, and if made with strictly parallel sides, would only touch the roll in contact with it at the ends. It is therefore necessary to make the bottom roll slightly larger in the center than at the ends so that when the full weight is on, it will be deflected sufficiently to make the upper surface touch the lower surface of the next roll throughout the full length. The amount of deflection has been found by trial and in the case of a 16" roll 80" long, is about .00225", which necessitates the roll being .0045" larger in the center than at the ends.

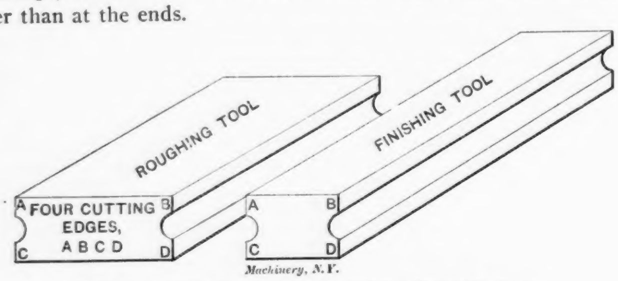


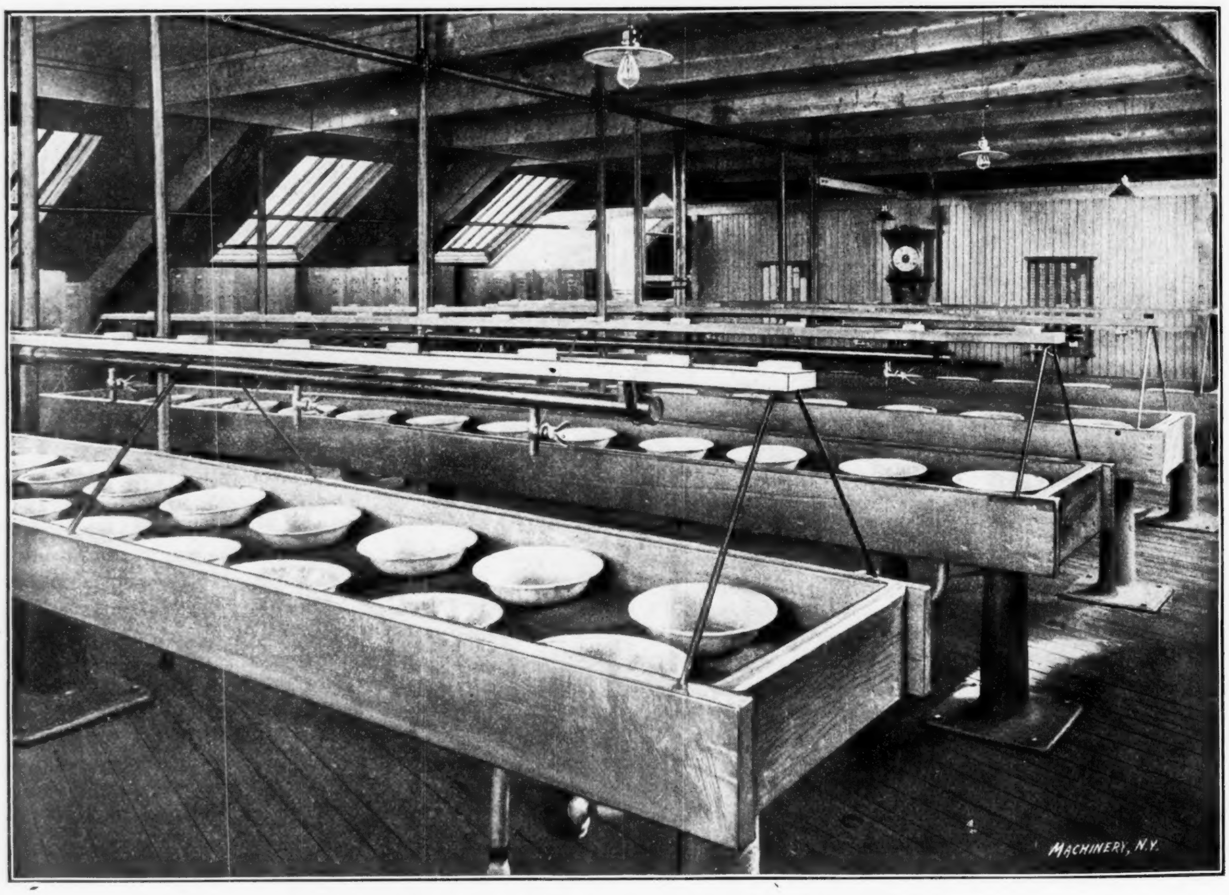
Fig. 9. Lathe Tools used in Turning Calender Rolls.

The trial for accuracy is to pile all the rolls up in their housings, often making a height of ten or twelve feet, and then trying them by the "light" test. A lighted candle, or better an incandescent lamp, is carried along the juncture of any two rolls while an observer on the opposite side sees if light shows through at any point. If not, the rolls pass muster; but if light shows through to any extent, the stack is taken down and the defective rolls are again ground until perfect. The final test cannot be made until all the rolls are in the stack with the pressure on, so the operator is never quite sure of the result of his work until it is all assembled. By experience, however, he learns to what extent the light ought to show between any two rolls without the total load. Thus with the bottom roll in place and with three or four intermediate rolls on top of it, light will be visible for a distance of perhaps two feet from each end between the bottom roll and the next one above.

What seems peculiar is that such accuracy is required of the rolls when new, while they are apparently able to turn out fairly good work when badly worn. Rolls often are returned for grinding after having been subjected to years of service and will be found to have differences of diameter throughout their length of 1-20" or more. One explanation may be that the rolls get out of alignment and wear so that the line of juncture remains perfect, although the opposite sides are not parallel. Such a roll would be a hyperboloid. In turning rolls for rolling hot sheet metal, it is the practice to turn one roll of this shape to compensate for the greater expansion in the center of the roll.

Chilled rolls are cast vertically in "chills," and have a depth of hardened metal of about 5-8". They are required to "clean up" by the removal of about 1-8" from the exterior or a reduction 1-4" in diameter. A roll is first centered and the necks rough turned for the roll lathe, the roll being supported by the necks and in the center during the turning. The tools used are flat sections of steel similar to those shown in Fig. 9, and vary in length from 4" for roughing to perhaps 6" for finishing. There is no carriage to a roll lathe, but instead a flat topped bed extends along in front of the roll on a level with the center and with its inner side as close to the roll as possible. On this bed are laid the turning tools, which are clamped down with two set screws behind them for forcing them against the roll. The operator turns a section of the roll to the required diameter and then moves the tool along for another section. Two or three tools may be used on one roll and the operator generally runs two machines. After a roll has been turned, it is again put on centers and the necks turned to the finish size, after which they are ground dead true. A roll is then ready for grinding. When grinding the rolls, one operator also tends two machines and even then time must hang heavily on him, as the work is light and extremely monotonous.

Roll turners and roll grinders are not generally machinists, but are men who have been specially trained for the work. The average machinist would find the work very trying, as it requires the greatest patience and there is no variety to give spice to it.



Wash Rooms and Lockers of the Builders Iron Foundry, Providence, R. I.

AN INEXPENSIVE AND CONVENIENT WASH-ROOM.

The Builders' Iron Foundry shops, Providence, R. I., have recently been equipped with a new shop wash-room, the furnishing and fittings of which are somewhat different from any that we have seen elsewhere. The room has been found quite satisfactory, especially in view of the moderate expense at which it was equipped.

The shops of the Builders' Iron Foundry are located in buildings that have been used for machine shop purposes for many years and as is usual in such cases the available room is limited and it is desired to keep the expenditures for improvements and additions within a reasonable figure. Part of the works are located in a three-story building and the new wash-room is on the third floor of this building. Lockers for the employees are provided in the same room, and a Rochester time-recording clock is placed there, as will be noted in the illustration. Upon arrival each man places his outer garments in his locker and the clock stamps his starting time upon a card which he carries. The clock again stamps his time when he leaves work and at the end of the week his card shows the number of hours worked during the six days, and he receives a new card for the following week. The lockers are of wood, 10" x 11" x 65" inside and each contains a shelf and three hooks and is provided with a lock and name-plate.

The plan adopted for washing is for each man to have an individual basin of gray enameled steel. The two advantages claimed for separate basins are that a man does not have to wash in water that has been used by his neighbor, and he can draw a second supply of water for his face, after removing the dirt and oil from his hands. The basins are considerably heavier than those usually sold, and were selected with reference to their non-chipping or flaking qualities.

Each of the five wooden sinks is 20 feet long and 32 inches wide, and accommodates 24 men. The sinks are supported by cast-iron standards or columns, such as are furnished by the Builders' Iron Foundry for their grinders. The sinks slant from the middle of their length toward both ends and are piped to the sewer through large and easily cleaned traps.

In cool weather the water is heated in a tank above the ceiling by a steam coil. The faucets are of the self-closing variety, and there are six above each sink. The soap which is furnished by this company is made by J. O. Draper at Pawtucket, and is termed "Steamer Soap." It seems to possess sufficient alkali to cleanse with ease and yet not enough to roughen one's hands. The cost is two cents for a six-ounce cake.

The approximate costs, exclusive of the room, were as follows:

5 wooden sinks @ $40	$200.00
15 cast-iron legs for same	60.00
120 enameled wash basins @ .35	42.00
Piping and Plumbing	275.00
Lockers	200.00
Time Recording Clock	150.00

The room is 38 feet square and accommodates 120 men.

* * *

A NEW SYSTEM OF WELDING.

The system recently developed by Dr. Hans Goldschmidt, Germany, for obtaining high temperature by a chemical reaction, equaling or exceeding the temperature of the electric arc, is of quite as much interest to the mechanical engineer as to the chemist. Aluminum and oxygen have a strong affinity for each other and when these two elements are brought together under favorable conditions a vigorous reaction takes place, resulting in temperatures of over 5,000 degrees F. There have been obstacles in the way of applying this process to any practical work, mainly because of the difficulty in getting the reaction started and of its extreme rapidity when once under way. Dr. Goldschmidt, however, has succeeded in overcoming both these difficulties. He uses powdered aluminum and a metallic oxide, the latter supplying the oxygen. These elements require a high initial temperature to bring about a reaction, but he discovered that by mixing with these a quantity of the chemical, barium superoxide, ignition could easily be started. This having been accomplished, he found that the combustion could be regulated by the manner in which the powder was added. This, in brief, is a statement of what has been accomplished chemically, but of more interest to those engaged in mechanical work are the results that have been attained through this discovery.

In a late number of Feilden's Magazine is a fully illustrated article describing some of the applications that have already been made in Germany, and to this article we are indebted for the brief description which follows. An important application of the process is found in metallurgy in the reduction of metals, but its chief use will evidently be for welding together lengths of wrought-iron pipe of various sizes, for welding rails and for repairing faulty steel castings, etc. The heating agent or powder has been patented and is known as "Thermit.' The process of welding pipe consists in clamping together the two ends and then casting on the joint in order to bring the iron up to a welding heat. The increase in temperature causes the pipes to expand, but they are prevented from doing so longitudinally by the clamps. The expansion, therefore, taking place within a restricted area, acts as a welding force upon the pipe faces, pressing the hot iron together. For the whole operation there is required only a slag-lined fire-clay crucible, a pair of tongs, a clamp, a box of Thermit and some matches. Before the molten Thermit is applied the joint is surrounded with a mold of sheet iron, backed up with sand or clay, which acts as a receptacle for the Thermit when it is poured. The requisite welding heat is imparted to the pipe in a very short time and after the joint has been allowed to cool the solidified Thermit can be knocked off with a few blows from the hammer, leaving the pipe clean and smooth at the joint. A peculiar property of the Thermit appears to be that it does not attach itself permanently to the pipe or other metal being welded, as might be expected.

The same process is used in welding rails, and in a number of instances where the experiment has been tried the welds have been found quite as satisfactory as the usual fishplate joint, besides being nearly if not quite as cheap, and in the case of electric roads affording better conduction of the current.

In repairing steel castings having imperfections, the Thermit is allowed to run into the blowhole where it remains firmly attached, owing to the irregularities of the surface. A remarkable and somewhat startling result that has been obtained in the application of this compound is in softening and even penetrating armor plate or plates used for safes or vaults. A nickel steel plate about 1¼" thick was easily penetrated in a short time by the application of molten Thermit, and a hole of any dimension could be made through such a plate by simply pouring the Thermit so as to follow a circular line enclosing what was to be the hole. An exceedingly valuable application of the compound appears to be that the welds stand well under test. Pipes which have been welded can be bent to almost any angle without disturbing the welded connection, and it is also believed that the process can be applied as cheaply as can flanged joints. The main difficulty in welding pipes is that one would be unable to remove a length which, however, in many instances where piping is expected to be permanent, would be of no particular disadvantage.

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JUNIOR MEETING, A. S. M. E.

The Junior meeting of the American Society of Mechanical Engineers, held at the society's house in New York on Jan. 8, was largely attended and of unusual interest. The paper was by Cornelius Vanderbilt, the young millionaire engineer, upon the subject of the corrugated firebox for locomotives which he has designed and placed on trial upon a number of locomotives. These fireboxes are of the marine type, with annular corrugations, and are intended to do away with the stay bolt problem. Tests upon locomotives having these fireboxes have shown good results. Following Mr. Vanderbilt's address, the process of making the corrugated furnaces was briefly described by Mr. W. E. Hill, Vice-President of the Continental Iron Works, of Brooklyn, N. Y. At first it was necesary to make the tubes in two lengths and then weld the parts together circumferentially. The corrugations were 1½ inches deep. A new rolling machine has now been constructed which will roll a furnace 15 feet long and will make the corrugations 2 inches deep. The largest fireboxes of this type are about five feet in diameter and of steel ¾-inch thick. It is found that the expansion and contraction of the firebox shell keep its outer surface free from scale. If this type of firebox should successfully solve the staybolt problem alone, it would be quite enough. The annual cost of staybolt renewal is one of the principal items of expense in locomotive maintenance

O. M. & CO.—1.

HOW A SHOP SHOULD GROW.

Elmer E. Warner.

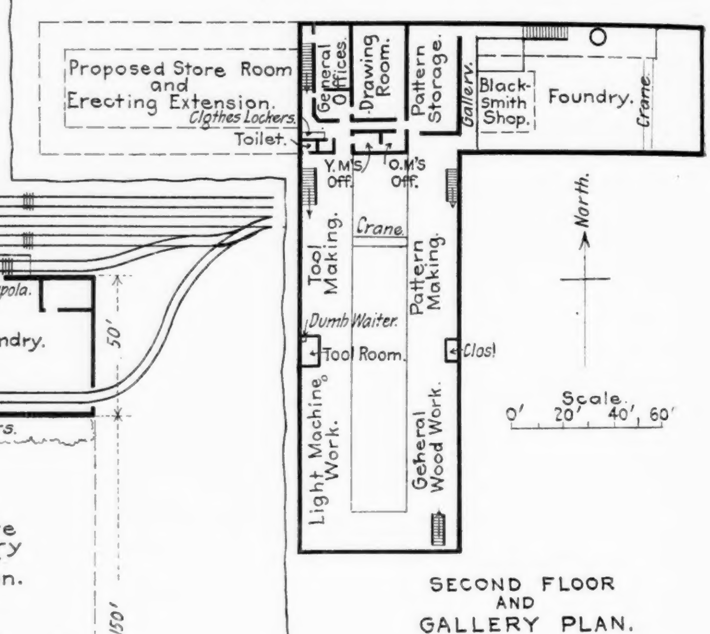
MOST machinists in the United States look forward to having shops of their own, and all small shops expect to grow big; and yet, in how few is there any provision for growth?

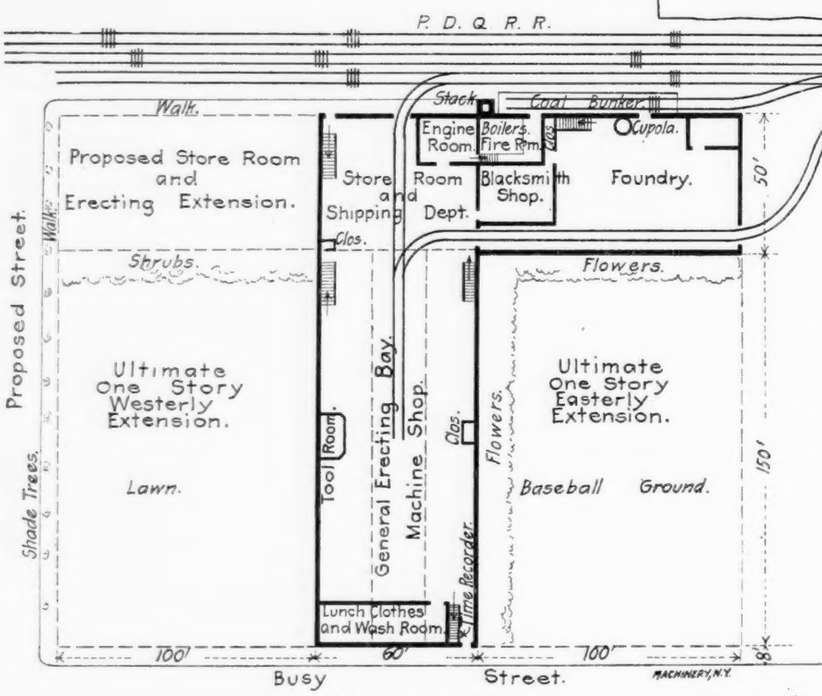
The embryo machine shop has one door and very few windows. The desk of the Old Man is near that door, littered with sketches, letters and circulars. There is a drawing board behind it, and a few shelves behind that for the storage of small tools, Stubs steel, cap screws, etc., with perhaps a little window for passing these out to the men. One line of shafting runs from end to end of the room, with an engine on one end and boiler room and blacksmith shop just behind; and, if fortunate, he will have a back yard, littered with junk, and a driveway for bringing in coal and heavy supplies. There may also be a little up-stairs pattern and wood-working shop

But the Old Man is Superintendent, Manager, Shipping Clerk, Draftsman and Typewriter. The youngest apprentice slings out the tools, runs errands and dusts off the desk faithfully a few days before Christmas each year. Observe now the beautiful economies of this small situation. The whole working force is directly under the eye of the O. M. His voice can be easily heard in the remotest corner of the shop, and even wakes the sleeping echoes in the old back yard. No expensive speaking tube or telephone system is necessary. All things enter and leave at one point. All things revolve in parabolic orbits, with the O. M. as a generatrix.

But the O. M.'s Yankee ingenuity, working on some breakdown problem on an engine or press, evolves some valuable improvement, and his ambition then is to expand the little repair shop into a manufactory and his exclusive proprietorship into a stock company. Here is the O. M.'s day of peril and tribulation. How to grow easily! The O. M. was born poor. He never loaned a dollar that he did not expect to get back Saturday night. He never did a job of work unless the money was in sight, and he never ran in debt. Ten chances to one, his ingrained caution will keep him adding to the little shop by inches, and piecing out old tools when new are needed, with the place continually upset, and a patchwork of antiquities for the sheriff in the wind-up. There is only one door of salvation for the O. M., and that is to get hold of a young one. Not too young, but just about fifteen years out of a good school, ten years out of a thorough apprenticeship in all branches of machine making, six years as a roving journeyman in the best shops in the land, and four as a steady, married, progressive foreman and draftsman in a line similar to the one the O. M. essays, and, with all this, he must be the right man. And this young man will sit down and talk to the O. M. as he would to his own father.

"O. M.," he will say, "you've got to get out of this. I know it's going to hurt you, but it's got to be done. I know a nice bit of land in a healthy and thriving suburb on the P. D. & Q. R. R. that we can get cheap. A good big piece to grow on and enough to spare to cut up into lots for the boys' homes. Company will put in a switch free. Town will run a street through and furnish water free for ten years—take some stock, too. Oh, it won't cost you much to move! That junk out there," with a contemptuous jerk of his thumb at the O. M.'s treasured machine tools, "can stay just where it is, for all the use we've got for it.





FIRST FLOOR PLAN

Sketch of New Shops proposed for O. M. & Co.

"Now, don't cry, O. M.!" (Every hammer dent and file mark is dear to the O. M.) "Perhaps you can find a bigger fool than yourself to take the whole plant as it stands, and at a good round figure, too, if you've got your last year's profits pat. Now, here's a little sketch of the shop you can boss some fine day, just to make you feel better, and with your name along the whole front of it, too. One hundred and fifty feet long by sixty wide. Twenty-foot central erecting bay, with crane. Two twenty-foot two-story bays at sides, with ten-foot ceilings.

"Now note, our railroad switch runs right through the end of the building. Coal storage under it, and right alongside the boilers, at the farther corner. Foundry and blacksmith shop just beyond. Storeroom in the near corner, at present. We can wing out a hundred feet along the track for extra storage space when we need it, eh, O. M.? And then we'll have a perfect T, with its head along the track. Our luck, too! it heads toward the north, so that the machine shop is lighted east, south and west, and plenty of room to grow toward the south.

"You see my scheme, O. M. We track directly from our

stores to blacksmith shop and foundry, and by side switch up the central bay of the machine shop, under the crane. Room for more boilers here and bigger engine there; direct connected dynamo for light and power; clutch connection—my own patent.

"'Where do you come in?' Oh, we'll have you properly fixed! See that gallery running across the head of the T and connecting the second story of the side bays, just over the switch and storeroom? Well, you come right in there. Draftsman, too, with patternmaker off in the gallery toward the foundry. Toolmakers on the other side. Got you right at the center of things, all done up in glass, too. Give you a roving commission to walk clear around the gallery as often as you like, and in on the one looking down on foundry and blacksmith shop, too. Easy to grow—that's the idea. Main piping double size don't cost much more. Plenty of unions and Ts.

"But Labor is what counts, O. M., don't you know."

"But labor is what counts, O. M., don't you know? Labor is our high-priced commodity. Ever figure how much time is spent away from the machines? Never did, eh? Well, it would surprise you. Feet X trips to grinding wheel. Feet X by trips to tool room. Feet X trips to water closet. Feet X trips to drinking water. One to two hours a day in the waste basket. Fact, O. M. Figures from life. You can't cut the times much, but you can cut the feet. Now, we strike three centers of population, so to speak, in the main building, and put in three sets of closets on first floor, two on second. One at the head, for office, drawing room and toolmakers; one underneath for storeroom and adjacent shop; one a little more than half way round the gallery on east side and underneath, and one in foundry. That keeps your maximum walk down to about seventy-five feet, and it pays. Drinking water should be more plentifully distributed. Now a neat combination cooler, to put against posts, with connections to water pipes above and drains below. Wide-lipped tray, so there's little slop or bother.

"Tool-room, you see, is about half way down gallery, at end of tool department, and runs down to main floor, but carries only the finer and more uncommon tools. Got to have tools where they are used. Take drills and large taps, for example. Here are most of the drill presses, grouped from large to small. Here is a big locker for foreman on drill press work, and here are the drills and taps, and the boy that grinds them and checks them out. Every lathe carries a good set of tools, charged up to the man who runs it, and so on, ad infinitum.

"We will use part of that hundred-foot storeroom wing for clothes lockers and wash rooms, when we get it, eh, O. M.? But at present, we will put them away down at the further end of the main shop. We shan't use that much for a while, and such things belong to the extreme radius of action, so to speak, in a shop. Aren't used at all during working hours, and should take space worth little for work or storage, and near the street. We can make them in sections, and quite portable.

"Now, I tell you, O. M., we've got to have things up to date, and figure to grow easily and have a chance to spread out, and we'll get all the capital we need, never fear!"

* * * * *

And so the O. M.'s cloud bears a silver lining, and he dreams in a restless sleep during the night that he is a one hundred and fifty horse-power tandem compound engine with dynamo attachment, making two hundred and fifty revolutions per minute, until his wife quiets him down with a hair pin and he subsides into an unhaunted and childlike sleep.

* * *

THE METRIC SYSTEM.*

AN INTERESTING DISCUSSION OF ITS POSSIBILITIES AS A UNIVERSAL SYSTEM.

W. H. SARGENT.

Why is not the metric system more popular? It is not yet in use by a very large portion of the civilized world. Mexico has just adopted it. Russia uses it a little, owing to the influence of her neighbors. It is legalized in Great Britain, but by a curious inconsistency tradesmen are not allowed to have on hand metric weights or measures, such an act being construed as an intent to defraud. In this country it is legal enough and has been for nearly forty years, but who uses it? Even if one were disposed to do so, it would be difficult to make the tradespeople, the butcher, the baker, the candlestick maker, understand the terms, let alone their values.

The absurdities of our present system are only equaled by the excuses which we make for their continuance. It is held that our present system is convenient enough; that any change would be a hardship upon the laboring people who do not belong to the educated classes and who do not learn easily, many of them being somewhat advanced in years. If they mastered any one table in the metric system, say the table of linear measure, they would virtually have them all, since they are all related and dependent upon each other and all employ the same terms. Instead of this they use what is considered the easier and simpler American system of feet and inches. If one happen to be a "wood butcher" he will use an inch divided into 16ths and 32ds. But such measurements are not fine enough for a modern machinist; he must have the inch divided differently, since he works to hundredths and thousandths of an inch. The optician cannot use either of these systems; he must have the inch divided into 12 parts which he calls "lines," and he rates his lenses as so many lines diameter. None of these systems, however, suit the engineer. He is a finer grain and must also have a system of his own. He cannot use the plebeian inch, 12 to the foot; he divides a foot into 10 inches and figures in tenths and hundredths of feet. Really, our method is simplicity personified!

We are considering our system in its adaptability to the working man. Now suppose he wishes to weigh something, which system do you think would be the easier? You say the American, of course, as it is the simpler method and has been used these many years! To be sure, a hundred weight is not a hundred of any kind of weight. An ounce of metallic silver contains 480 grains, but an ounce of nitrate of silver contains 437 1-2 grains. No wonder people quarrel over free silver. Sixteen ounces may make a pound, but 12 of a heavier kind of ounce make another kind of pound and the heavier ounces make the lighter pound. Then there are fluid ounces which are not ounces at all except on the theory that "a pint's a pound the whole world round." Buy gems and they are weighed in "carats"; buy carrots and they are weighed in pounds. Buy medicine and get grains; buy grain and get bushels. This is all so simple that "the wayfaring men, though fools, need not err therein"! Our abbreviation for pounds (lbs.) is a contraction of Libras, a Spanish weight about one per cent. greater than one pound. Our "dwt." does not stand for "dollar-weight" as might be supposed since it is about the weight of a gold dollar, but rather for "penny-weight," although there is no penny of anywhere near this weight! So much for the way we weigh. Are our standards of measure any more logical? Our quart and gallon are only about five-sixths as much as the English quart and gallon. Our bushel is three per

* In December, 1898, was published an article by Prof. John E. Sweet, advocating the continued use of the English systems of weights and measures. We are glad to publish herewith an opposite view of the case, although it does not accord with the editorial opinions.—EDITOR.

cent. less than theirs and their ton exceeds ours by 12 per cent. Our terms are the same as theirs, but these terms have not the same meaning. Can anything be more illogical, more inconvenient, more unsystematic than our present "system"? And yet this is exactly what its opponents say about the metric system! They claim that subdivisions by tens and hundreds are "agin natur," since the year is not divided into ten months nor the months into 100 days. They forget that the metric system deals not with the flight of time but rather with material things. They also claim that it will be impracticable to have ten points to the compass or 100 degrees in a circle. They lay great stress on the fact that quantities cannot be halved or quartered as readily as at present, but there seems to be no good reason why one cannot buy a quarter of a kilo of tea so long as he has a quarter of a dollar in payment. There are those who maintain that the system could not be recovered if the present standards were lost; that while it was intended to have the meter a certain portion of the earth's meridian, yet through inaccurate measurements this was not accomplished, hence the system is of no avail. It would seem possible to perpetuate the system by carefully depositing several similar standards in several different cities widely separated. Any event which would destroy them all at the same time would probably put mankind beyond the need of any system. It is a curious argument against the meter to claim that it is merely a hypothetical standard, not found in nature, and yet to cling to the foot which is derived from the foot of Hercules, a purely mythical personage! It is often urged against the adoption of the metric system, and with some show of reason, that the manufacturer would be obliged to make great sacrifices for a mere sentiment; that all his drawings would need be made over, and his jigs, templets and gages thrown away and new ones made. What is the object of a jig? Is it not to avoid making measurements? Does not a workman lay out his work by a templet, drill it by a jig and test it by a gage without a rule of any kind? He may know nothing about the measurements involved. He does

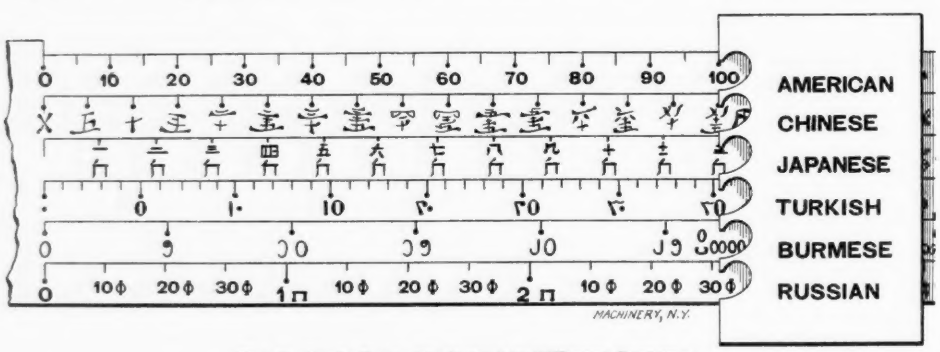


Fig. 2. Scale Beam Graduated in Different Systems.

not know, neither does he care, whether the measurements were originally laid out in metric or in English, and for that matter there is no English dimension which cannot be translated into a corresponding metric equivalent. Rules are made with one edge graduated in inches and fractions and the other side in millimeters, so that a drawing or a pattern may be measured in either system indifferently. If the plan is drawn to some scale smaller than whole size, as 1-2 inch to a foot, a scale can readily be constructed so that the drawings may also be measured in metric. To do this, lay off 39.37 inches of the scale to which the plan is made and divide this distance into 100 parts. This will then represent a meter and its subdivisions in the proportion of 1-2 inch per foot (see Fig. 1). When you come to think of it, a conversion table giving the metric equivalents of feet and inches will be no more inconvenient than the tables which we now have stamped on micrometer gages and which we prize so highly, giving the decimal equivalents of common fractions of an inch.

Some factories would gain by changing systems; others would lose. In the manufacture of weighing machinery, under the present confused condition, it is frequently necessary to have the scale beams graduated in more than one standard, as English and Japanese, or Chinese and metric. Fig. 2 shows a weighing beam graduated so that six different standards may be weighed with the same poise. Some of the difficulties of accomplishing this will be learned by the fact that the dividing machine must be adjusted to mark 35.2 Turkish Okas, or 27.4 Burmese Viss, or 2.77 Russian Poods in the same space on the beam as that occupied by 100 American Pounds. Scale manufacturers would therefore welcome the change, but gear makers probably would not, as the metric gear system differs somewhat from the present method. Instead of dividing the number of teeth by the pitch diameter to determine the "pitch," we will then divide the pitch diameter (in millimeters) by the number of teeth. In the first case we find the number of teeth to the inch; in the latter, the number of millimeters to the tooth. A pitch number in the metric is not therefore the same as in the American system, as will be seen by the accompanying table:

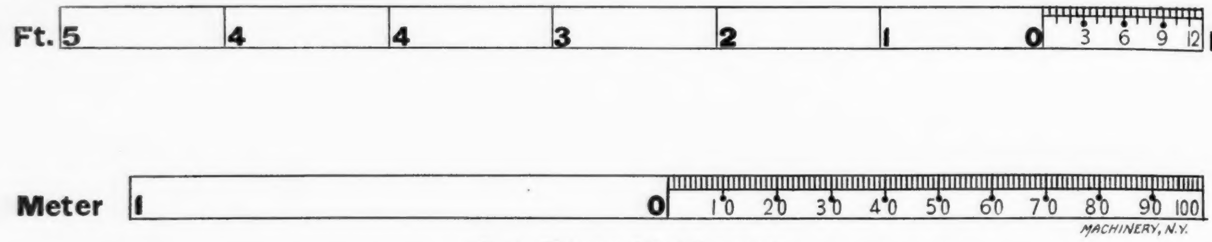


Fig. 1. Meters and Feet Compared.

Metric Pitch Number.	American Pitch Number (Diametral).
1	24
1 1-4	20
1 1-2	16
1 3-4	14
2	12
2 1-2	10
3	8
4	6
5	5
6	4
7	3 1-2
8	3
9	2 3-4
10	2 1-2

Why is not the metric system more popular? It is because it is as yet a theory and not a fact. People are not yet accustomed to "think in metric." The way to adopt it is to use it. The question of adopting an American Commission of Weights and Measures is already before Congress and will be brought up again at the next session. It is proposed to create a bureau similar in character to those in England and Germany, with authority to undertake all functions contemplated by the clause in our Constitution relative to "fixing the standard of weights and measures." International commerce and the progress of science now demand a uniform system of weights and measures, and this will surely be the metric; not because it is founded on the ten millionth part of the distance from earth to heaven, but because it is orderly, coherent and exact.

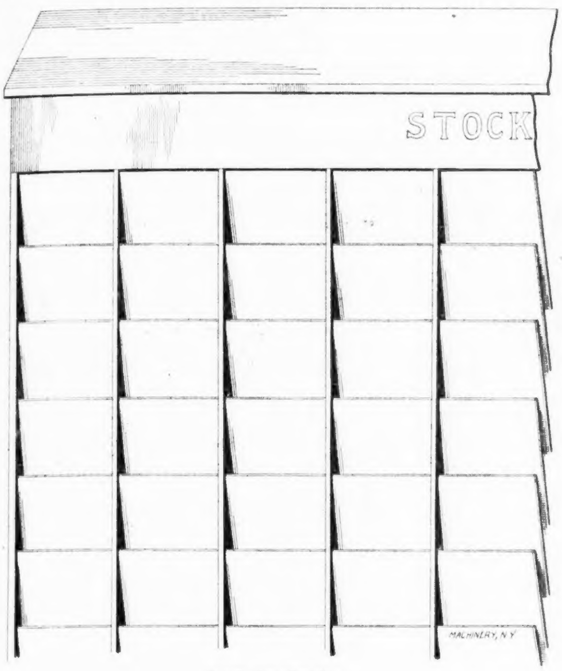
* * *

In an address recently delivered before the students of Purdue University, W. H. Marshall concludes that the coming American locomotive for passenger service is the ten wheel type or that having six driving wheels and a four-wheel leading truck. His argument was that the tractive force required to start a passenger train of twelve or fifteen cars and get it quickly under headway, is more than is available with the present safe weights per driving wheel, where there are four driving wheels. The four-wheel leading truck admits of a still heavier boiler, as a large proportion of the weight can be carried on the truck and the weight per driving wheel kept below the maximum limit.

STOCK ROOM SYSTEM.

S. E. E.

The following stock room system is a modification of one that has been used by the writer at the works of the National Cash Register Co., Dayton, O. It represents the results of his own experience, as well as of the experience of others. The system as used at those works has proved highly satisfactory and it is believed that the modifications made in the following description adapt it to the needs of firms engaged in other lines of work.



Rack for Cards.

The bins, drawers and shelves of the stock room should, first of all, be arranged in such a manner that the material may be handled rapidly. They should not be too high, six or seven feet being a good height. The danger to life and limb in the handling of the stock is thus diminished, and the store keeper is enabled to handle the stock to better advantage. These bins, drawers, etc., should all be painted of one color, and numbered consecutively. Like material should be arranged together, with the large sizes at the bottom, and running up to the small. Enough space should be allowed so that you may have ample room for stock at the busy season. The size should be marked on each bin, drawer, or shelf, and over the set of bins set aside for any particular class of stock, the name should be placed, such as "Rod Brass, Soft." It is well to leave under each division a few extra bins, drawers, or shelves, as the case may be, for excess of stock. When the extra bins are used for this purpose, a small card should be placed in plain sight, on the original stock bin. The card should state the number of the bin in which the extra stock is placed, and also give the amount and the date at which the stock was placed there.

The stock being all arranged, the next step is the card system. First, a cabinet for holding the cards should be made. It is composed of a series of inclined pockets, placed so the heading of each stock card may be seen at a glance. A pocket is allowed for each size of material carried in stock. The cards being printed, as shown in the sketch, the bin number is placed at the top. This enables any one not acquainted with the stock room, to find any material desired. The size of the material should be written on the first line of the card, and the name on the next.

The horizontal lines should be divided into four perpendicular columns. The first on the left hand side should be reserved for data in regard to orders "standing out." The next for data relative to stock received; the third, to stock delivered, and the last, to the amount of stock on hand.

The cards are made of some medium-weight cardboard, and should measure 4" x 8". In the upper right-hand corner of the card, a hole may be punched and on the reverse side of the card a small paste-board disc attached, divided into four colors, so that it may be revolved, showing only one color at a time, through the opening punched in the card. This is to enable one to ascertain by a glance at the stock board just in what condition the stock is. Thus the green might represent the stock at high-water mark, or above; the blue, the stock at the normal point, when an order should be placed for more stock; the red, low-water mark or below; and the yellow, that the stock is exhausted.

When the cards are filled, the records may be continued under the same headings, by attaching slips of paper ruled the same as the cards, and the same size from the heading down. When everything is ready, the invoice of the stock can be taken and the amount in stock of each item placed in the column set aside on the card for the purpose. At the same time care should be taken to see that the size and kind of material, as well as the bin number, are on the card. A card should be made out for each item of stock carried, and placed in the pockets on the stock board, in alphabetical order, keeping each class by itself.

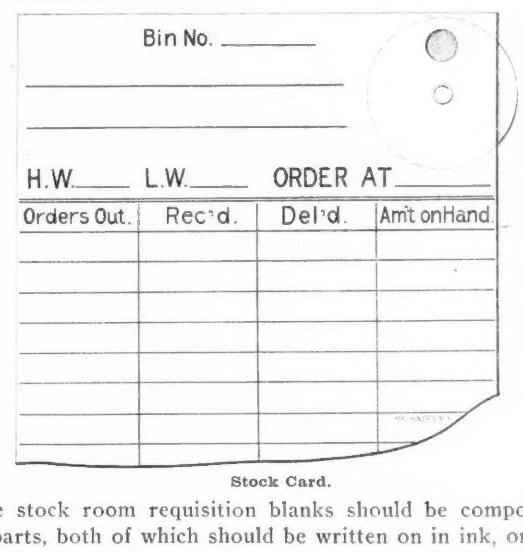
Over each class of cards a heading should be placed. Material given out should be placed in the "delivered" column, accompanied by the date, and the balance in stock placed under the former amount on hand. Material received should be handled in the same manner. In this way the man in charge can tell any minute just what he has on hand.

The many advantages of this system over the ordinary drawer card system, or the system of having the stock card attached to each bin, are obvious. This system is also much above the large clumsy stock-book, which so many are using.

The receiving, inspection and purchasing departments should be run in as close lines as possible, as far as the regular stock is concerned, so that there may be no delay in getting material for the stock department.

All material must be ordered through the purchasing department, on a written requisition. The purchasing department gives each requisition a number. This number, with the date and amount ordered, should be placed on the stock card, in the column set aside for that purpose.

Fifty requisitions to a book make one easy to handle, and as the books are filled, they should be carefully filed away for future reference.



Stock Card.

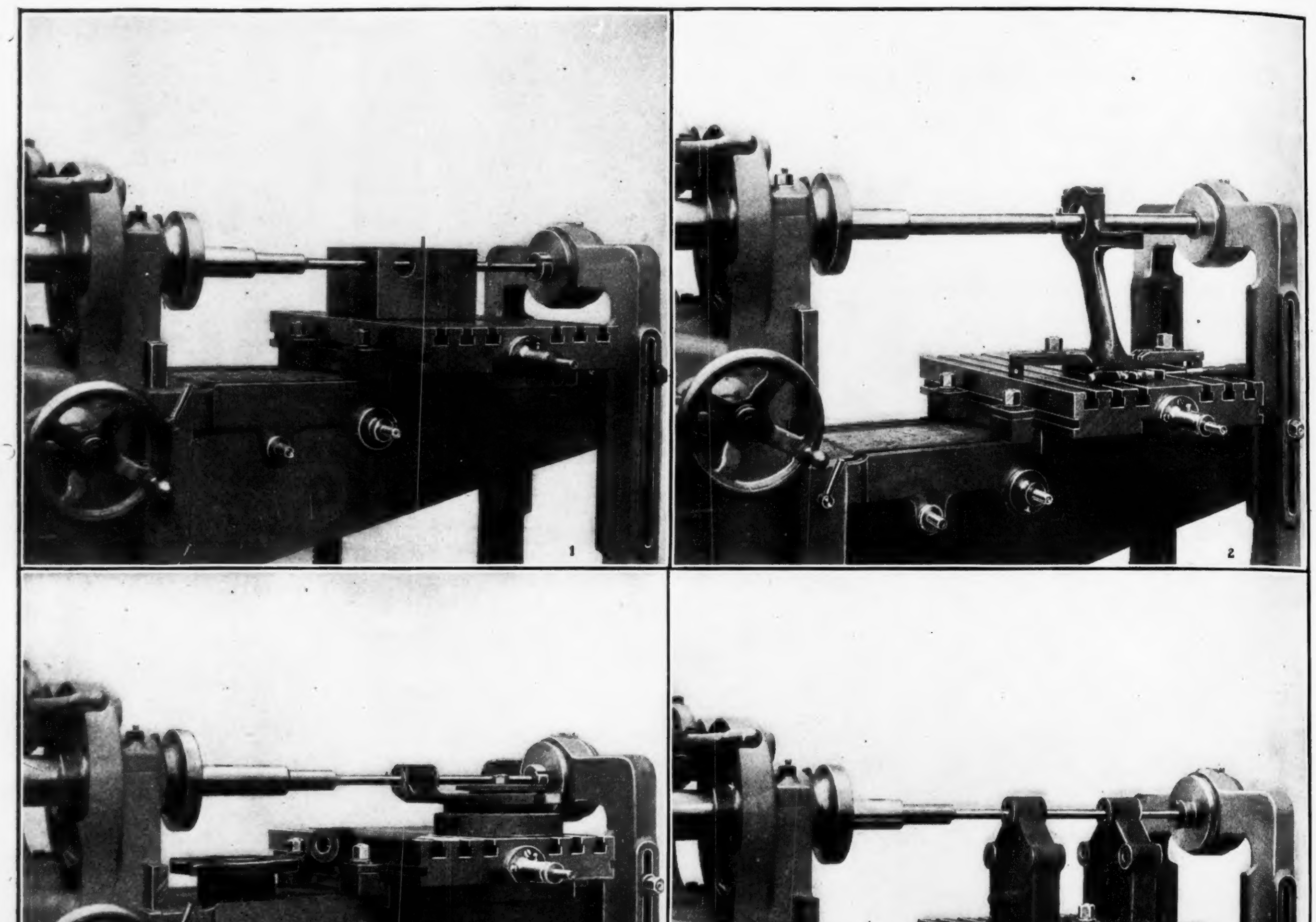
The stock room requisition blanks should be composed of two parts, both of which should be written on in ink, one part to be kept in the purchasing department, and the other, of course, in the stock room.

The receiving department, upon coming into receipt of the goods, immediately turns them over to the inspection department, where they are inspected, and turned over to the stock room, with a note giving the size and amount. These are at once entered on the card, and the material is put away, the note from the inspector being filed for future reference.

For the guidance of the store keeper, it is well to form an estimate of the amount of each kind of stock used in a year. From this the "high-water" mark and the "low-water" mark, as well as the point from which to order, can be estimated. These amounts, or figures should then be placed on the stock-card opposite their respective headings.

EXAMPLES OF WORK ON THE HORIZONTAL BORING MACHINE.

The Newark Machine Tool Works, Newark, N. J., in their efforts to sell the horizontal boring machine which they build as a specialty, have found to their great surprise that comparatively few mechanics understand the uses for which this machine is best adapted. Although a few machine tool builders understand fully how to use the horizontal boring machine, by far the great majority of mechanical engineers regard it as a tool useful only for boring cylinders, and it is a usual experience to have a comparison made between it and the special cylinder boring machine when, in fact, the two machines are widely separated in their respective fields of usefulness. The ordinary cylinder borer can be used for no other job, while the horizontal boring machine is not excelled by any machine in the shop, generally speaking, for every kind of accurate drilling and boring. There are many jobs which cannot be done on the drilling machine at all without the use of the drill-jig, which the horizontal boring machine can perform perfectly well and with equal accuracy, without a drill jig or fixture of any kind. This will be quite clear if we recall to our mind that the table and carriage movements of the horizontal boring



Boring and Drilling on the Horizontal Boring Machine.

machine are very like the knee and table movements of the plain milling machine. Every one has seen the milling machine used when it became necessary to drill or bore accurate holes. The horizontal boring machine will do equally nice work, but it covers a great field and is more rapid, owing to features adapting it to this work not possible with a machine designed primarily for milling.

As indicating the extent to which the horizontal boring machine can be used for a variety of work, the Newark Machine Tool Works instance that the Brown & Sharpe Mfg. Co. have in operation about two dozen machines of this type. Much of their jig work is done on these, even in the case of large jigs, weighing as much as 500 pounds.

The cuts on the opposite page illustrate a variety of uses to which the horizontal boring machine is adapted, where it is necessary to perform accurate boring and drilling.

Fig. 1 shows the machine making a box drill jig. This is a job which is generally done on the universal milling machine. When the cross-feed and the vertical table movements are in perfect alignment with the bar, it will be evident that this job can be done on the horizontal boring machine rapidly and with great accuracy.

Fig. 2 shows a bracket which is very much offset from the vertical line. In this case the bore must be at exact vertical and horizontal distances. The job offers no difficulty in the horizontal boring machine, although it would be almost impossible to get good results by any other machine without using a drilling fixture.

In Fig. 3, the operation of drilling a worm shaft bracket casting, is shown.The casting is fitted to receive a worm gear, the worm shaft bearing being offset both right and left. The cut shows the casting with the worm shaft bearing about to be bored, while a casting of the other hand is placed on the table near by. This bearing, of course, must be bored at a fixed center distance. Where there were a number of these bearings to be finished, the job was done in a very simple way by placing on the carriage a fixture turned to receive the hub of the casting. When the center distance of the fixture from the bar center had been set to the exact distance between the worm and the gear center, the worm shaft bearings were finished very rapidly by dropping them into this fixture, and boring out the bearings with the boring bar. By this method they all came absolutely alike.

Fig. 4 illustrates a bracket with three pairs of bearings for running gearing. Here, also, the centers must be exact. After boring the bearing for the intermediate shaft, the centers for the two other shafts are quickly found by moving the table vertically and feeding the cross-feed out or in to a gage. This gives most accurate results

In Figs. 5 and 6 we have the drilling of another worm box which has a little hub on the back, fitting into a recess of the bracket. The hub and face are turned on a lathe and the bracket is then bolted to the fixture. The bore for the worm gear shaft is then finished with extreme accuracy. In the second cut the casting is shown, held by a stud through this hole, while the worm shaft bearings are being bored to a fixed distance. The cut shows the use of a drill jig, although this was not absolutely necessary.

* * *

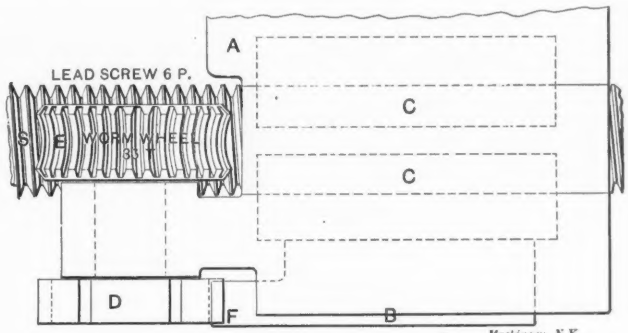
THREAD CATCHING DEVICE FOR THE LATHE.

We are indebted to Mr. Howard P. Fairfield, Worcester, Mass., for the accompanying sketch of a thread-catching device that was applied to several lathes in the Worcester Polytechnic Institute some years ago by Mr. O. S. Walker of the same city. In conversation with the writer, Mr. Walker stated that he first saw it in the shops of the E. W. Bliss Co., Brooklyn, N. Y., nearly twenty years ago.

The arrangement is the same in principle as that described in Machinery for May, 1899, but differs from it in being positive in action while the one described depends on the operator to engage the split nut when the disc is turned to a certain position. The latter device appears to have been originated by William Gleason, of Rochester, N. Y., nearly thirty years ago.

The lathes to which this device was applied had the lead screw at the back, which explains the peculiar sketch. A is a casting bolted to the back of the carriage and supporting the split nut indicated by the dotted lines at C C. At the left of and supported by A is a vertical spindle carrying on its upper end the worm-wheel E, engaged with the lead screw, and at the lower end the disc D. The worm-wheel should either have as many teeth as there are threads per inch in the lead screw S, or a number of teeth which is some multiple of the number of threads per inch.

The disc D has equidistant slots milled across its periphery, the number of slots being as many as the number of teeth in the worm-wheel is times the number of threads per inch of the lead screw. In this instance, the lead screw has six threads per inch, the worm-wheel has thirty-six teeth and there are six slots milled in the periphery of D. Fastened to the lower side of the lower half nut is the latch F, which engages with one of the slots or notches in D when the split nut is closed. It is thus



Details of Device.

evident that when the split nut has been disengaged from the lead screw and the carriage run back for a fresh cut, the lead screw cannot again be engaged until the worm-wheel turns into position for one of the slots to correspond with the latch F. The latch being engaged, the worm-wheel ceases to turn, acting then as a sort of half nut on the screw. Therefore the lead screw can only be engaged at even inches of its length and necessarily the thread-cutting tool must engage with a lead already started when it is a whole number per inch and greater than one or equal to one. On fractional threads, the device fails as constructed, since it would be possible to split a lead already started. However, by having three slots in the disc D, instead of six, fractional threads having one-half for the fraction could be caught and with only one slot in the disc, fractional threads including one-half, one-third, one-sixth, two-thirds and five-sixths could be caught, but under these conditions the time required to bring the notch around so that the latch F could be engaged would usually be nearly equal to that required to reverse and run the carriage back, especially on short work.

* * *

In his paper at the last meeting of the American Society of Mechanical Engineers, Mr. William Sangster presents some interesting facts regarding fan blower practice in connection with cupola furnaces and forges. He points out that "in hardly any other class of machinery is the method of application of so great importance as it is in the case of centrifugal fans. The conditions of one installation are usually so different from those of any other that hard-and-fast rules are out of the question." Briefly summarized he shows that the horse power required to produce blast for a cupola is equal to 3-10 of the tons melted per hour multiplied by the pressure of blast in ounces per square inch. For forge blast an allowance of ¼ horse power may be made per forge and for exhausting smoke therefrom the power required will be 44 H. P. per forge.

* * *

A record feat in long distance transmission of electricity has been accomplished at the Snoqualmie Falls water power plant, Washington, on the Pacific Slope. These falls have an available energy of from 30,000 to 100,000 H. P., there being a vertical drop of 270 feet. Impulse wheels are used and the long distance transmission lines are of aluminum wire. In the early part of the winter all the transmission lines of the company were connected up in one continual circuit and tests were conducted for experimental purposes. Power was transmitted 150 miles, 3-phase generators furnishing the current.

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—16.

MILLING MACHINE ATTACHMENTS.

W. H. Van Dervoort.

The milling machine is capable of receiving a large variety of attachments for performing special operations, or regular operations with greater facility than can be had with the machine in its standard form.

The vise is a regular attachment on all universal machines and plain machines of the column pattern. It is of two standard forms; plain, as shown in Fig 139, and swivel as shown in Fig. 140. The plain vise is provided with tongues to fit the wards in the work table and can be readily set with the jaws parallel with or at right angles to the spindle. It cannot, however, be conveniently set at any other angle. The swivel vise has a graduated base resting on a plate which is tongued and bolted to the wards in the table. The swivel vise is very convenient for angular milling. A special tilting vise shown in Fig. 141 is, with its tilting jaws and swivel base, well adapted to the milling of a large variety of angular surfaces. In all milling machine vises the movable jaw is accurately fitted and gibbed to the body, and the jaw faces, which are usually made of soft steel, are secured to the jaws by means of screws. The surface of the jaw faces should be kept true and smooth, as they will then hold finished work surfaces true for the cut and without injury to the work. Extra jaw faces hardened and with roughed surfaces may be used for holding forgings, castings and rough work. For the holding of special and irregular work special formed jaw faces may be substituted for the regular ones.

As the universal dividing head is a part of the universal milling machine, it is not considered as an attachment. The plain index head already described under Fig. 136, however, is strictly a milling machine attachment. A first class, three-jawed universal chuck fitted to the spindle of the index head is a very necessary accessory to the machine, as much of the work to be operated upon can or must be held in the chuck.

The vertical spindle milling attachment shown in Fig. 142 as made by the Brown and Sharpe Mfg. Co., when applied to the plain or universal machines, converts them into vertical spindle machines. These attachments are supported on the overhanging arm, which is reversed in its bearings, and the nose of the spindle bearing. The vertical spindle is driven from the main spindle by bevel gears. A graduated index enables it to be set at any desired angle from the vertical, thus making it possible to mill many angular surfaces with a plain end or shank milling cutter. These attachments are very convenient for the cutting of T-slots, key seating and profiling, as well as angular work. Another attachment, termed a universal milling attachment, is shown in Fig. 143, as made by the Cincinnati Milling Mch. Co. This has in addition to the vertical spindle an auxiliary one at right angles to it and driven from it by means of spiral gears. With this auxiliary spindle set parallel with the surface of the work table and its line of travel, it makes a convenient rack cutting attachment. In connection with the spiral head on the universal machines, it can be used to advantage in cutting spirals of large spiral angle, as the axis of the cutter can be set to the spiral angle instead of the work table. The auxiliary spindle can readily be removed when not in use, leaving a simple vertical milling attachment. Attachments of this class become of special value in shops when the amount of work that can be advantageously done by vertical milling does not warrant putting in a vertical milling machine.

In Fig. 144 is shown a circular milling attachment. It consists of a circular plate gibbed to a round base and provided with a worm gear into which the feed worm meshes. The base clamps to the table of the milling machine and the work is secured to the top of the circular table, suitable T-slots being provided for the clamp bolts. This attachment is of special value on the vertical milling machines and in connection with the vertical milling attachments on the column pattern plain and universal machines. It may be provided with an automatic feed, which increases materially its usefulness where a considerable amount of work is to be done on it. This attachment can, when the table is suitably gibbed to the base, be clamped to a substantial right angle knee plate and the faces and periphery of work, as gear blanks, pulleys, etc., successfully milled with cutters on the main spindle of the machine. For this class of work an attachment similar to the one shown in Fig. 145 is best adapted. The construction of this attachment is evident. As shown, it is arranged to carry two blanks to be operated upon at the same time, the rims being completely finished at one rotation of the work.

It is frequently desirable to use cutters of small diameter and requiring high rotative speed in the larger sizes of milling machines. As the spindle speeds are altogether too slow for this purpose, high speed milling attachments, one of which is shown in Fig. 146, are provided. This consists of a spindle carrying a small sheave pulley and mounted in bearings formed in a collet which fits the hole in the main spindle. It may be driven direct from a pulley on the countershaft but preferably from the large step of the spindle cone, as shown in the figure, as in that case the regular feeds may be used and the speed of the cutter varied by shifting the regular drive belt in the usual manner.

A rack-cutting attachment is shown in Fig. 147. A device similar to this is necessary when racks of any considerable length are to be cut on a milling machine, as the motion of the table in line with the spindle is not great, and the distance the cutter can be set from the nose of the spindle is also small. With the attachment shown, the length of the rack section that can be cut at one setting is limited by the longitudinal travel of the table. In the device shown, the frame is securely attached to the front face of the column and the cutter spindle driven by a suitable chain of gears. The rack blank is clamped in the special vise shown, and the depth and settings for each cut are obtained by means of the graduated dials on elevating and longitudinal screws. The feed is in and out by hand or automatically, if the machine is provided with automatic lateral feeds.

The spiral cutting attachment shown in Fig. 149 is adapted, in connection with the plain milling machine, to the cutting of spirals. It frequently happens that the amount of spiral milling to be done in a shop would not warrant putting in a universal machine, and in such cases the attachment shown serves its purpose admirably. It consists of a circular base, carrying a suitable frame in which a work table is gibbed. The frame is preferably detachable from the base, graduated and capable of being clamped at any desired angle with the spindle of the machine. The work table carries a head and tail stock for supporting the work. The head stock spindle carries at its outer end a bevel gear which revolves upon it. The rear face of the bevel gear is provided with circles of drilled holes, similar to an index plate. A radial arm keyed to the spindle carries a pin which engages in the holes of the plate and through which the drive is carried from the gears to the spindle. The balance of the gear combination is a suitable system of change gears substantially as described in connection with the universal dividing head. A worm feed operated by hand is usually provided on attachments of this class.

An attachment for the cutting of cams is shown in the diagram in Fig. 150. It consists of a base plate A, which can be bolted to the work table of the milling machine, and a head stock which is mounted on the slide C. C is gibbed to slide in the base plate. The head stock carries a spindle with a worm gear G on its outer end. The worm S engages the gear and the spindle is given a slow feed rotation by the pulley P or a crank which can be substituted in its place when power feed is not available. R is a small roller mounted on a suitable support which extends upward from the base plate. The master cam F, which is of the same contour as the required cam, is mounted on the spindle, as is also the work. The work table of the milling machine is adjusted vertically and laterally so as to bring the center of the roller R and the milling cutter in the same axial line. A weight W connected by a rope, over a sheave at the end of the table, with the slide C, holds the master cam constantly in contact with the roller as the spindle and work are rotated. The master cam is usually of the exact size of the required cam, and in that case, the roller R should be of the same diameter as the milling cutter. If the master cam is larger or smaller than the required cam, the diameter of the roller, for the same diameter of the cutter, must be decreased or increased as the case may be, in order that the sum of the master cam and the roller radii will at all points equal the sum of the required cam and the cutter radii. For the cutting of cylindrical cams the spindle must stand at right angles with the cutter spindle. The attachment is so

connected that the spindle head can readily be secured in such a position on the slide plate C.

An oil pump for supplying lubrication to the cutter and work when milling steel can properly come under the head of attachments. In Fig. 148 is shown such a pump. It is attached to a suitable reservoir and driven from an independent countershaft.

* * *

A Wisconsin cat lately jumped into a flywheel 12 feet in diameter and making 87 turns a minute. It was 2½ hours before the engine could be stopped, when the cat was still alive, according to "The Woodworker," a reliable paper. This may be a good record for Wisconsin, but it is hardly comparable with the achievement of a Rhode Island feline. This animal, according to the story, was rewarded for her faithful duties in keeping out intruding rodents by a free ride in a centrifugal oil separator. After a week's recuperation, following the episode, she appeared to enjoy good health, but was in need of a new suit of clothes.

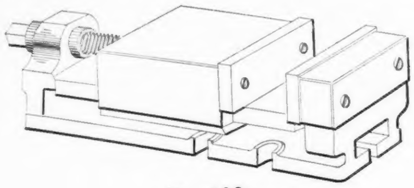


Fig. 139

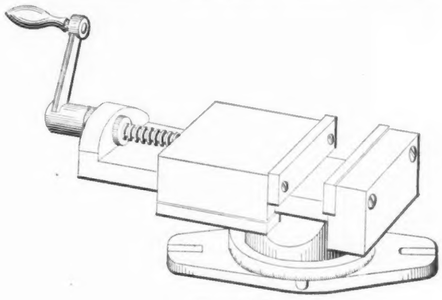


Fig. 140

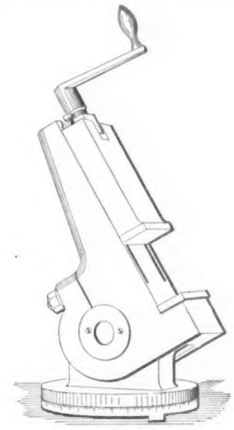


Fig. 141

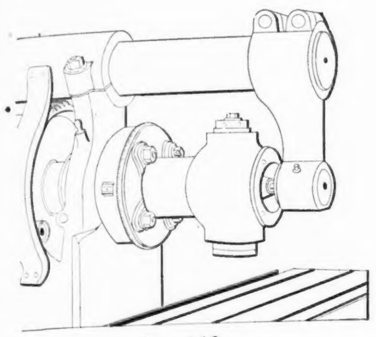


Fig. 142

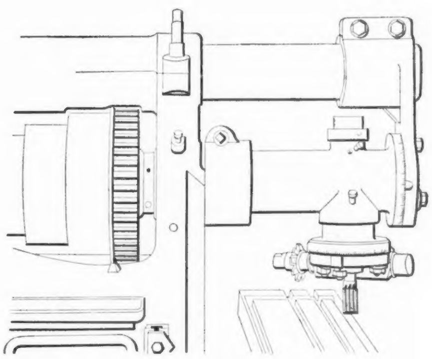
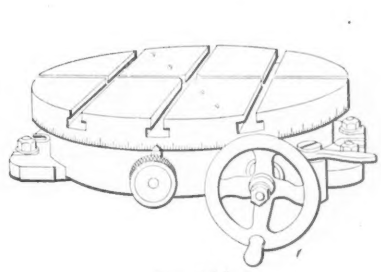


Fig. 143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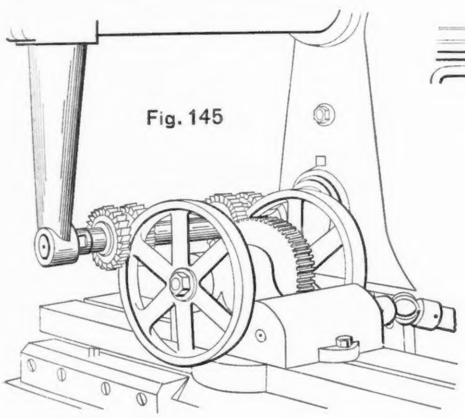
Fig. 145

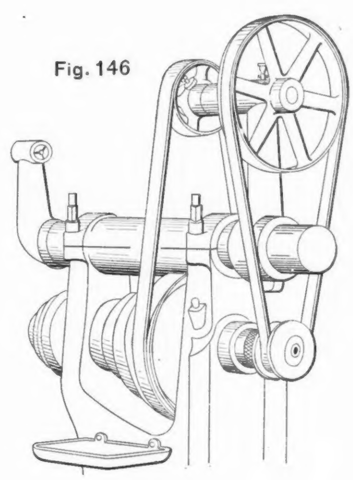
Fig. 146

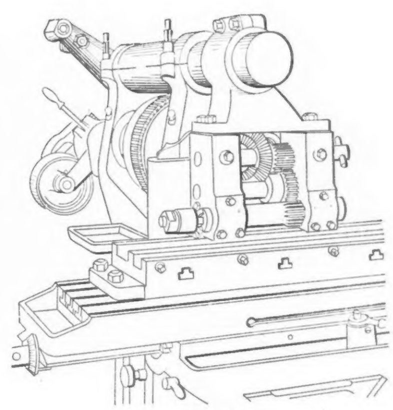
Fig. 147

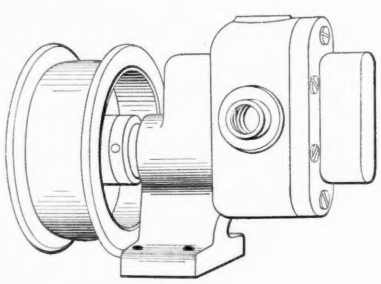
Fig. 148

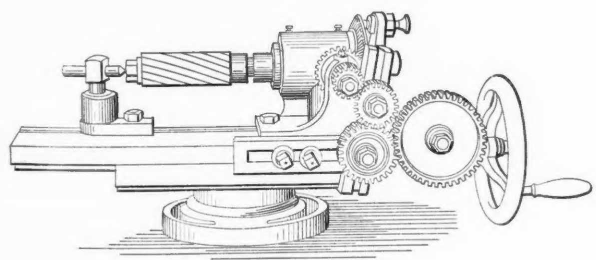
Fig. 149

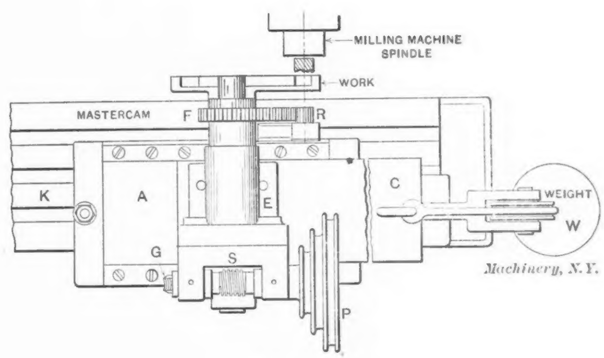

Fig. 150

Attachments for the Milling Machine made by the Brown & Sharpe Mfg. Co., the Cincinnati Milling Machine Co. and the Becker-Brainard Milling Machine Co.

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CIRCULATION STATEMENT.

The regular edition of MACHINERY for February is 26,500 copies.

MACHINERY has the largest paid-in-advance circulation of any mechanical paper in the world. No subscriber is entered on our mailing list until his subscription is paid for, and all subscriptions are stopped at expiration. Except on special quarterly numbers, no papers are sent free other than to advertisers, exchanges and circulation agents. AMERICAN MACHINERY is the title of the foreign edition, printed on thin paper and comprising all the reading and advertising matter in the domestic edition. The regular editions of MACHINERY for the last twelve months are given below:

1900.		1900.		1901.	
March	25,000	August	21,500	January	27,500
April	21,500	September	21,750	February	26,500
May	21,500	October	24,000		
June	27,500	November	25,000		
July	22,000	December	27,500		

THE VALUE OF A TECHNICAL PUBLICATION.

There are many who peruse the pages of journals of the character of MACHINERY who are not subscribers, but who have access to them in the reading rooms connected with various institutions. In this manner they can at little or no personal expense keep in touch with the world and be constantly informed of the new things coming up in their particular trade or profession. To some, the public reading room undoubtedly presents about their only opportunity for gratifying their thirst for knowledge and to such the public reading room is indeed a boon. Such readers, however, who could well afford to subscribe to the journals that particularly interest them, but who instead avail themselves of the opportunities of the reading room, lose the best benefits to be obtained from such publications, that is their value for future reference. A paper of the character of MACHINERY is not like a newspaper to be read and thrown away, but should be read and filed away for future reference. The subject that may appear unimportant to-day may be in the course of a few years, when a new position has been obtained, just the one that requires one's earnest attention and any available information on it will be eagerly welcomed. Again there is not the concentration of attention possible on reading an article in a public reading room as in the privacy of one's own apartments where the preceding numbers may also be referred to if occasion demands By all means personally subscribe to your favorite journal, read it and *keep* it.

* * *

During the past month there has been a great deal of matter published upon the accomplishments of the nineteenth century. The century is generally spoken of as one marked by inventive and industrial progress, but there appears to be, among the general press, a lack of appreciation of the important influence of machinery upon present day civilization. While it may be true that the most striking and far-reaching steps in the development of the century have been the advances in science and in the thought and moral condition of the world, nothing has so influenced every-day life as the inventions and improvements in machinery. They have made possible most of the necessities as well as the luxuries that people now enjoy. Carroll D. Wright, chief of the Department of Statistics, tersely says that this is an age in which "brain is king and machinery is the king's prime minister."

* * *

COMMENDABLE INSTITUTIONS.

Evidences frequently reach us showing a disposition on the part of manufacturers to make the work and surroundings of their employees as attractive, healthful and comfortable as possible. We have already called attention to shops where something is being done in this direction. This month three instances have come to our attention that are worthy of notice and that indicate a desire on the part of the different firms to consider the interests of their employees and indirectly, by this means, their own interests. One of these firms is the Cleveland Twist Drill Co., Cleveland, O., who have issued a pamphlet showing eleven views of their works, among which appears a large lunch room and a well appointed kitchen, a commodious reading room supplied with periodicals, and a circulating library. One view shows a group of machinists standing about a piano, the title reading "A little music after dinner is pleasant and elevating." Still another view is of a mechanical drawing class attending night school.

The Seaboard Air Line Railway shops, at Portsmouth, Va., have a circulating library of over three thousand volumes for the benefit of the railway employees and their families. The books represent all classes of literature and include all the best technical books that would be suitable for a library of this character. The reading tables are liberally supplied with various weekly and monthly publications, including MACHINERY, which, we are informed, is highly esteemed. The library building is situated on the company's grounds, in close proximity to the shops, and makes a popular resort for the employees. The upper rooms are given up to the use of the shop brass band. The library is in charge of Librarian, Mr. C. E. Smith, who informed the writer that the institution is not only self-supporting, but that it also practically maintains the band. The source of income is principally from a nearby park, which is under the library management. The dues are nominal, being only twenty-five cents per quarter, or one dollar per year. The secretary is Mr. J. Thomas Dunn, toolmaker in the machine shop.

Another of these instances is the work that is being accomplished by an evening school established by the American Machine & Foundry Co., Hanover, Pa., in the interests of their employees. The school has been in existence six months and is patronized by the apprentices and mechanics who have not had the advantage of good schooling when young. The company write us that this school is held in one of the public school buildings and is under the supervision of their chief draftsman, Mr. L. Schlutter, a graduate of a technical school in Germany. No special qualifications are required of the boys or men, except a willingness to devote two evenings a week to the work. They first receive instruction in elementary arithmetic and are then carried through higher branches as rapidly as possible. They are also instructed in mechanical drawing and so become familiar with drawings, make sketches rapidly and well, figuring almost entirely in decimals, which, the company say is very important

in their work. This work is of a very close nature, the micrometer being universally used in the shop, and the experience the pupils get in the school aids them greatly in the decimal figuring.

The results of such institutions as the foregoing are far-reaching and cannot fail to be beneficial to both the employees who avail themselves of their advantages and to the companies who have so generously provided for them.

* * *

NOTES AND COMMENT.

Purdue University, which has been the leader in locomotive experimental work, now has established a locomotive museum. It is proposed to gather specimens of locomotives that have at one time or another been standard types, but have been replaced by more modern and heavier machines. Such locomotives are placed out of service by the various railroads in the natural order of events, and the trustees of the University ask roads having such machines, not duplicates of those already in the museum, to allow the locomotives to be stored at the museum at Lafayette, subject to the call of the roads at any time, should it be desired to place them in commission again.

In the endeavor to make a flexible staybolt, the mechanical superintendent of the Intercolonial Ry., of Canada, has devised one that essentially consists of a wire rope center, which is welded together at the ends so that it may be threaded. To make a bolt 1" in diameter, a piece of ⅜" round iron, of suitable length is used as a core, on which is placed a bundle of iron wires, each ⅛" in diameter. A ferrule is slipped on each end of the bundle and then both ends are heated and welded into a solid mass. The ends are then turned and threaded in the usual manner. The central wire forms a sort of backbone that supports the staybolt when being machined and screwed in place. We are not informed as to results obtained by practical use.

An item published in a recent issue of a railway magazine states that a Southern master mechanic has borrowed a set of patterns for a horizontal boring mill from a Western technical school. His intention is to build a boring mill for the railway shops of which he is in charge. The chances are that the machine, when finished, will have cost the railway fifty per cent. more than it would have if purchased direct from some reputable builder of such machines and if as good as one bought, it will be little less than a miracle. Anyone familiar with the difficulties encountered by master mechanics in obtaining adequate machine tools, will not wonder at the method pursued by the Southern official to equip his shop. Requisitions for machine tools costing a few hundred dollars, are often ruthlessly turned down by the intelligent general manager, as being an unnecessary expense, when such tools can be built, whereas, the labor and materials required for building the same in the shops may be considerably more than the manufacturer's price, but that is another pill that seems much easier for the average railway official to swallow.

In the November, 1900, number we called attention to a gas engine method developed by Prof. Donat Banke, Austria, by which a spray of water is injected into the charge of gas and air as it enters the cylinder. This enables the compression to be carried to a high pressure, since the vaporization of the water absorbs part of the heat of compression and prevents premature explosion from this source. In response to this item, Mr. William E. Carey, Springfield, Vt., calls our attention to a patent issued to him on Sept. 11, 1900, covering a gas engine in which he proposes to use this system, the idea having been developed entirely independently of Prof. Banke's work in Austria. It is set forth in Mr. Carey's patent specifications that he prefers to spray a charge of water into the charge while passing through the inlet pipe, which charge is instantly vaporized—and that the vaporizing of the water absorbs the heat of the cylinder and keeps it cool and the engine develops a great deal more power than it would without the charge of water. Mr. Carey's reasons for using the spray do not appear to be precisely the same as those of Prof. Banke, but the principle of the application is the same and it will be interesting to note whether this principle proves of real value in the future, when it has had a more extended trial.

THE USE OF BLAST FURNACE GAS.

During the past two years increasing attention has been given to the possibilities of blast furnace gas as a fuel for internal combustion motors, and particularly for gas engines of large size to supersede the steam cylinders of blowing engines. The difficulties to be overcome in the application of gas engines to this purpose are mainly the poor quality of blast furnace gas and its dusty and dirty character. It is said the gas produced by blast furnaces in the process of iron manufacture is sometimes so poor that it is almost impossible to burn it under boilers. When it is used in gas engines, therefore, exceptionally efficient means of ignition must be employed to secure regular running and reliability. To overcome the objections to the impurities in the gas, filtering and cleaning must be resorted to.

Various experiments have been made in this direction during the past five years and among these was an engine of 200 horse power, built at the Cockerill Works, Belgium, and tested in England in 1897. Calculations based on its performance led to the statement that gases which were producing 2,300 horse power by generating steam for steam engines, would produce 18,400 horse power if used in a gas engine cylinder. In 1899 the same Works built what is the largest single cylinder gas-engine ever constructed. The gas cylinder was 51" diameter by 55" stroke, and the engine ran at a speed of 80 revolutions per minute. It was connected to a blowing engine for furnishing blast and developed a power of 561 to 725 horse power in a blast cylinder. The Cockerill company is said to have under construction 35,000 horse power of their type of engines and other European firms are building plants for use with blast furnace gas.

DEGREE OF H. E. NOT YET CONFERRED.

Some over-enthusiastic newspaper man is responsible for the announcement which has been repeated from several sources, that Columbia University has introduced a course in automobile construction. It did not seem to us to be compatible with the dignity of a great university, situated in the metropolis of the country, that such a course should be included in its curriculum at the present state of the art. With all due respect to the possibilities and prospects of the automobile, it would be hard to conceive of anything that is in a more embryonic state at the present time. It is as yet but little more than a plaything in point of usefulness and the introduction of an automobile course would indicate an inclination to cater to popular favor that no university would be likely to countenance.

We addressed a letter upon the subject to Prof. Hutton, of Columbia University, and his reply amusingly shows from what slim sources great stories may grow. In the catalogue of the department of mechanical engineering are listed 40 distinct engineering subjects. One of these is the locomotive course and at the extreme end of a long list of sub-titles covered by the instruction is that of locomotive history and evolution. In order to be complete this must necessarily include the derivative of the locomotive, the traction engine, and the propulsion problem on streets. It is almost unavoidable, as Prof. Hutton explains, to pass from this to the motive power side of the steam carriage, and when this step is taken the discussion is naturally extended to other forms of motors. This constitutes the so-called "Automobile Course," which, as will be observed, is neither more nor less than an attempt to make a complete motive power study in connection with the locomotive. Thus, the mere fact that the automobile was mentioned in the catalogue in one subordinate place has led to the reports that have been circulated. The degree of H. E. (horseless engineer) will not yet be conferred, and the "chaffeur" will have to get his training elsewhere.

* * *

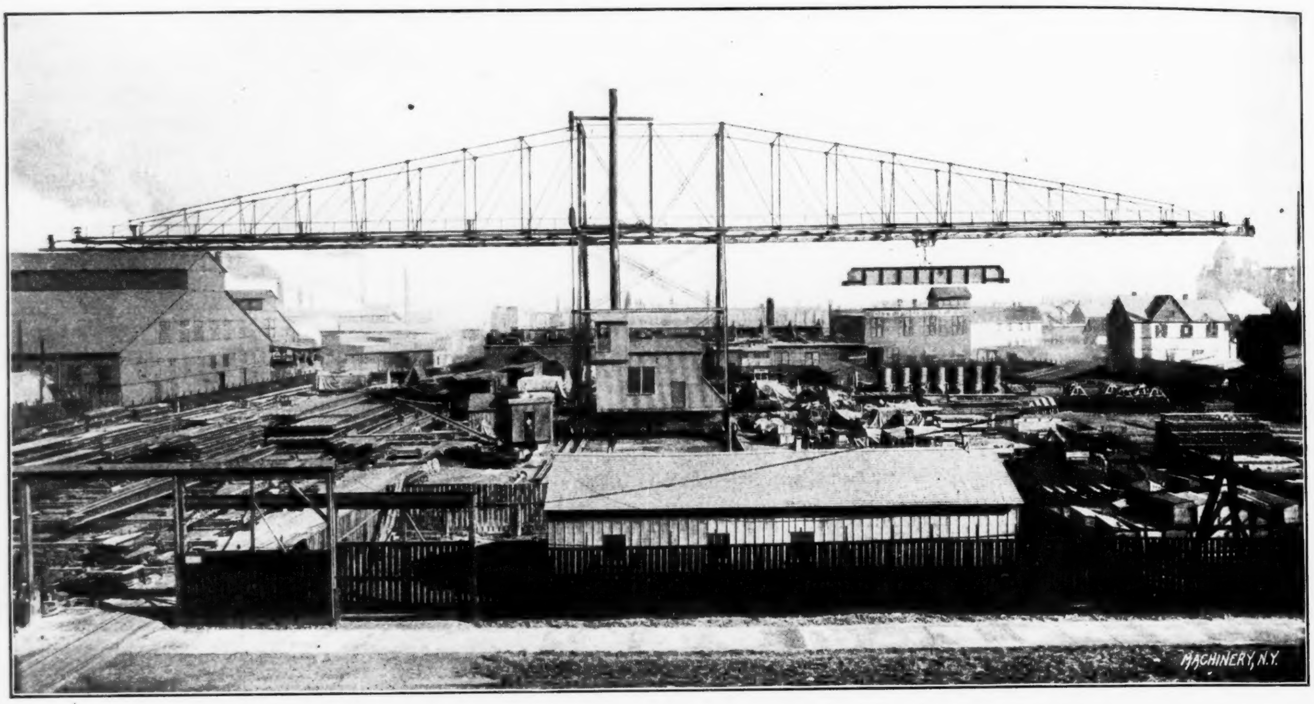
It is said that an order has been placed with Charles D. Mosher, naval architect and designer of high speed yachts for three fast twin-screw passenger steamers, to run from New York to suburban points on the Hudson. The total distance is 30 miles and it is expected that the boats will develop a speed of 35 miles an hour, and make the trip, including all stops, in one hour.

BROWN HOISTING MACHINERY CO.

VIEWS FROM THIS PLANT, WHICH WAS RECENTLY DESTROYED BY FIRE–NOVEL CRANES.

On this page are shown reproductions from two photographs taken at the works of the Brown Hoisting Machinery Co., Cleveland, Ohio, which were destroyed by fire on the morning of December 17. The photographs are in themselves of mechanical interest, because of the novel features of construction which they show, and are doubly interesting at this time in view of the recent destruction of this important plant. There were six immense buildings destroyed, covering a space 300 by 500 feet. Twelve hundred men were thrown out of employment, but the company took immediate steps to rebuild and arranged to carry out their contracts on hand through letting out work to other concerns. This they were enabled to do, also, from the fact that many of their patterns were saved.

An interior view of the main shop is shown in the second illustration. It was a building 300 feet long, with a central bay 60 feet wide, served by a crane of peculiar construction which was the most novel feature of the building. This crane dif-



Double Cantilever Crane in Yard of Brown Hoisting Machinery Co.

Interior View of Machine Shop, recently burned. A Traveling Crane was used in which the whole Crane moved crosswise instead of lengthwise of the Shop.

fered from the usual order of traveling cranes in that the main girder or runway upon which the car travels extended lengthwise of the shop instead of across the shop. This girder was of about the same length as the shop, or 300 feet, and the entire girder traveled crosswise of the shop whenever it was desired to move a casting or other load from one side of the shop to the other. The girder was supported by trolleys running on tracks on the lower members of the roof trusses, as clearly indicated in the engraving. The chief problem to be solved in moving the girder across the shop was to keep it in one straight line from end to end, so that every part of it would start and stop at the same time, and move with the same degree of speed. This was accomplished by connecting cables to both sides of the girder at frequent intervals. These cables extended at right angles from the girder to the sides of the shop, where they passed around sheaves and from thence to drums at one end of the shop. Any rotation of the drums caused the cables on one side of the girder to be payed out, each an equal amount, and on the other side to be taken in an equal amount. The movement of these cables thus served the double purpose of keeping the girder in line, and of moving it from side to side of the shop as desired.

Underneath the girder was the car carrying the hoisting mechanism of the crane. The car hung from tracks upon the girder and the operator rode with the car. It will be noted that the car was much longer than the car of the ordinary crane. This was necessary from the fact that the shop building was not substantial enough to enable the crane to support the heaviest loads except as the loads were distributed over a large area, which was accomplished by having the car supported by a considerable length of track.

This crane arrangement has both advantages and disadvantages. The latter are obvious, one of them being that a shop so equipped cannot be served by more than one crane. The main advantage is that a more rapid movement of the load is obtained the long way of the shop. Ordinarily, when a load is transported, it can be trolleyed sideways of the shop quicker than the whole crane can be moved up or down the shop to the desired point. With the plan just described, however, the crane, with its slow movement, travels the short way of the shop and the car, with its rapid movement, the long way of the shop.

Of scarcely less interest than the crane just described is the yard crane of the Brown Hoisting Machinery Co., shown in the first illustration. This is of the double cantilever type. as regularly made by this company, and the whole crane, which is supported by the central tower, travels upon tracks laid in the yard. A load of five tons can be safely supported at any point of the cantilevers and can be moved from one extreme to the other of the beams at a speed of 1,050 feet per minute. The crane itself moves at a speed of 230 feet per minute. The extreme length of the crane arms is 325 feet and the distance of the tramway above the yard is 58 feet.

* * *

An item was given in the November issue relative to a statement made by the "Railway Review" that loose driving wheels could be tightened by drilling a hole in the end of the axle and forcing in a pin of enough larger diameter to swell the axle to the required size for a press fit. The statement was adversely criticised, as it appeared incredible that a steel axle could be swelled sufficiently for a press fit by an 1¼" plug forced in the end. It appears, however, that the practice is being successfully followed on the Santa Fe Pacific Railway, and has been in vogue for a number of years. The hole in the axle is generally made about 1⅝" instead of 1¼" and the pin is turned 1-16" larger than the hole If the first trial does not prove successful in swelling the axle the required amount, the pin is drilled out and another still larger in diameter is pressed in to supplement the effect of the first.

* * *

An air compressor exploded at Morris Heights, N. Y., Dec. 27, and partially wrecked the factories of Charles L. Seabury & Co. and the Gas Engine & Power Co. The cylinder head was blown off with great violence and several workmen were seriously injured, but none fatally.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

BACKING OFF MILLING CUTTERS.

"Kid," Sparrow's Point, Md., says: "On one occasion we had to relieve the teeth of some concave milling cutters—an operation commonly known as backing off. The old way of doing this was to put an eccentric mandrel in the lathe, with a long lever on it, and work it by hand, which took a day or so for one cutter. We had an old speed lathe in the tool room, which I moved behind the lathe I was using, belting it from my countershaft. I bolted a lever from the faceplate on the speed lathe to that on the other lathe, placed the mill on the eccentric mandrel and the eccentric mandrel in the lathe. The throw was regulated by sliding the lever up or down in the slot of the faceplate, according to the number of teeth in the cutter. I found this a very satisfactory arrangement."

THREADING DEVICE.

I. D. Whitman, Reading, Pa., gives a method by which he was saved using extremely large gear wheels for thread cutting. It would have been necessary, he states, to have used a gear having 260 teeth, 16 diametral pitch when using the regular lead screw belonging to the lathe. Such a gear would, of course,

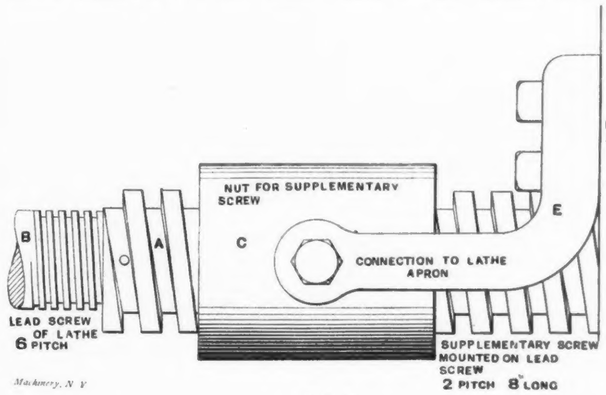


Fig. 1.

have been impracticable, so a supplementary hollow screw A, 8 inches long, of 2 pitch was made and slipped over the regular lead screw B and pinned in position. A nut C was made of the same pitch and fastened to the lathe apron as indicated. With the supplementary screw, the desired work was done with the largest change gear of 132 teeth, 12 pitch.

POOR MAN'S TURRET TOOL.

William Mohr, Pittsburg, Pa., sends what he calls a "poor man's" turret tool. Fig. 2 is the top view of the casting without the minor parts, and Fig. 3 is the side view of the tool ready for work. A lathesman need not tear down his cross slide to use this tool, because it simply takes the place of the tool-post and he still has the use of his compound rest to turn bevels while using this tool.

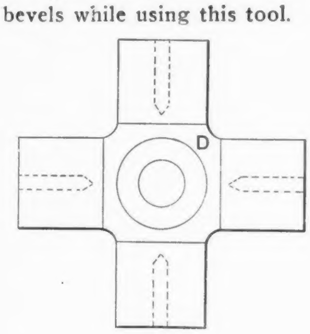


Fig 2.

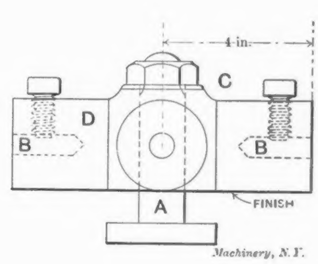


Fig. 3.

If the diameter of the arms is made 2½" or 3" and 4" long, from center of bolt A to each face, the tool will not be too clumsy to use on work between centers, as well as on chuck work. The size and depth of the cutter holes B could be drilled to suit the maker. The bottom face should be finished all over so as to make the tool solid when tightened. C is a steel washer. To use a boring tool, one of the cutter holes could be drilled somewhat larger than the rest, to admit a larger di-

ameter of steel, and a bushing, with a large hole in the shell to admit the setscrew, could be inserted when using the regular size cutter again.

METHOD FOR SPACING DIALS.

A. E. Phillips, Rockford, Ill., refers to "Easy Method of Spacing Dial Plates," which appeared on page 55 of the October, 1900, issue and sends another method for accomplishing the same object. The dial plate is first turned and bored and then notched on the periphery, using a square cutter instead of a V-shaped one. The plate is secured to the face plate of a lathe having a swing large enough to accommodate it in the necessary eccentric position, by being clamped as shown in the accompanying sketch. If the hole in the plate is large, it will be necessary to use a bushing, fitting both the bolt and the hole in the plate. The stop is made so that it fits closely in

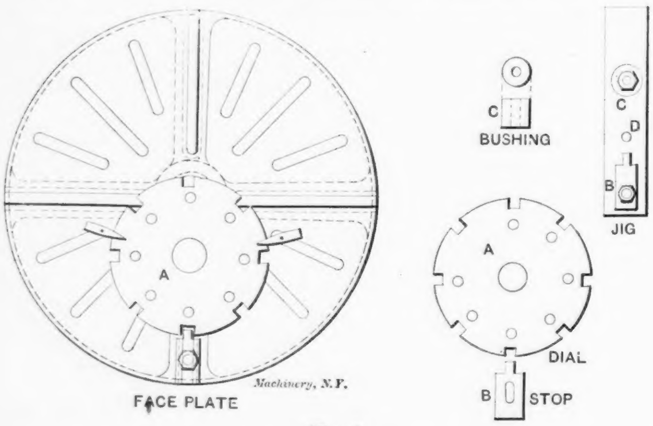


Fig. 4.

the notches in the dial. The reason for making the notches square is that there is not the likelihood of error from dirt getting into the notches, where they are square as there is with the V-shaped notches. Dirt in the latter will result in faulty spacing, while in the former case the stop will not enter if chips or dirt are present.

If it is preferred to drill the holes under a driller, a jig may be made, as indicated in the cut. The bushing is secured to the strap and the hole D and the stop B are located. To use it, the jig is laid on the dial with the side shown down and the holes are drilled through the hole D. In this case there is no bolt or clamps to loosen; all that is necessary is to raise the jig and turn the dial around one notch.

INSIDE CALIPERS FOR CLOSE SPACES.

Martin H. Ball, Lansingburg, N. Y., sends a sketch of inside calipers which are bent so as to be well adapted to calipering distances difficult of access, such as the keyway in a shaft and hub which does not extend beyond the hub, as indicated in Fig. 5. With the ordinary inside calipers, having straight legs

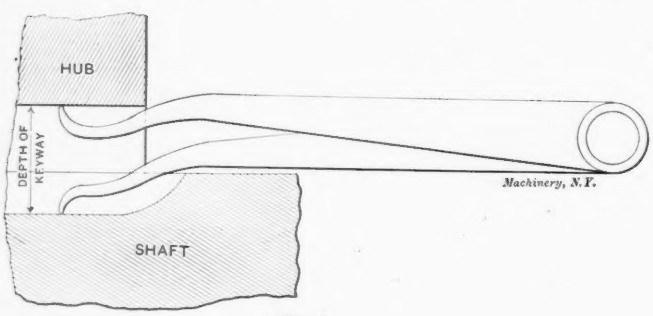


Fig. 5.

and which are commonly used for inside work, it is generally impossible to get the exact size, as the end which is held in the hand comes in contact with the shaft before the points both come into the same vertical plane. The sketch plainly shows how these calipers are made and how used. Any mechanic can easily bend a common pair to about the shape shown to accommodate this class of work.

TWO PLANER KINKS.

Arthur N. McAlpine, Auburn, N. Y., sends the accompanying sketch, Fig. 6, showing how a comparatively large base was planed on a 16" x 6' planer. The base was fastened to the cross rail as shown and the clapper box removed and fastened to an angle plate on the platen. A spring held the tool in po-

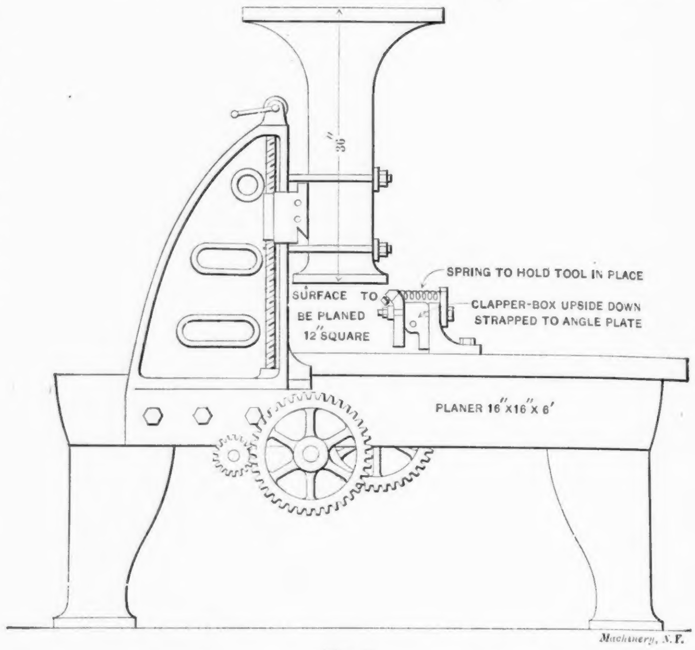


Fig. 6.

sition for the cut while also allowing it to clear the work when running back. The sketch shows the idea so clearly that no further explanation should be necessary.

J. R. Rand, Brattleboro, Vt., also recently had a job for a small planer that required a little management to effect the desired result. The casting to be planed was too wide to clear

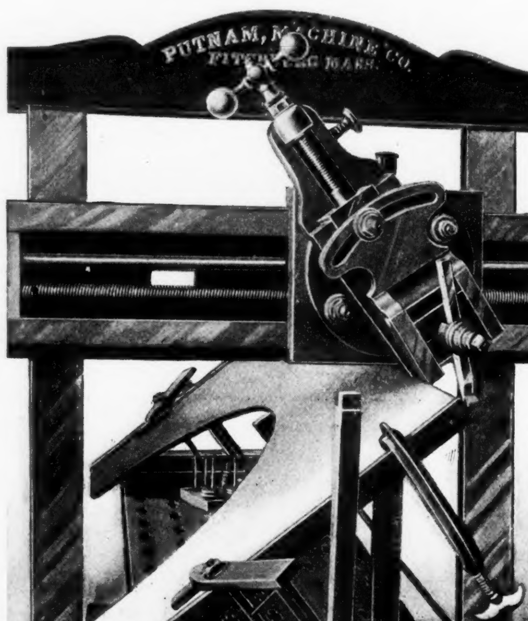


Fig. 7

the housings when laid on its side, or the cross rail when in a vertical position. The accompanying half-tone, Fig. 7, shows how the casting was blocked up on the platen to such an angle that would allow it to clear both the housings and cross rail. The head was then shifted to the proper angle to square up the edge of the piece.

NOTES ON SHOP PRACTICE.

A COLLECTION OF NOTES AND DATA TAKEN FROM A MECHANIC'S NOTE BOOK AND GATHERED FROM ACTUAL PRACTICE.

C. L G.

Drilling.

The cutting edges of twist drills are generally formed with a cutter of correct form to produce a radial line for cutting edge; hence straight flute drills necessitate a different form of cutter being used for milling the flutes.

Drills are generally made .002" or .003" taper per foot for clearance, and have the major part of land on the periphery ground away for the same purpose, about .003" on a side.

Drills for brass are generally made with straight flutes; cast iron and tool steel should in most cases have spiral flutes, at an angle of about 16°; soft steel, 22°.

Chucking drills, for use on cored holes, or as followers of solid twist drills, are quite often provided with from three to eight flutes, and the latter, on large work, are very efficient. Care should be taken in grinding, to insure all teeth cutting simultaneously. These tools are made of solid, shell, and inserted type.

The inserted type are preferable for straight flutes over 2¾" and for angular flutes over 4", on account of cost.

For drilling a long hole in a spindle the latter is supported in a back rest, and the drill enters a drill bushing to start perfectly true. Then by using a drill of Heyer type, i. e., one with one cutting edge, and ground on the outside, a long, straight hole may be readily produced. An ordinary twist drill will do practically the same if the center is made female, as in Fig.

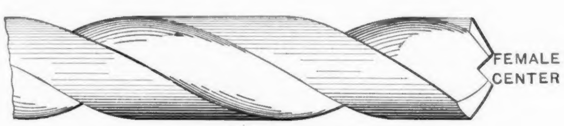


Fig. 1

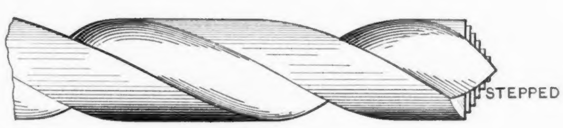


Fig. 2

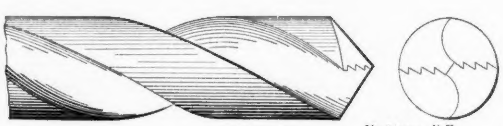


Fig. 3 *Machinery, N.Y.*

1, so as to have no difficulty at center, and if cutting edges are machined, ground and the hole not too deep.

On large holes, the Heyer drill is ground so as to break up chips, as shown in Fig. 2.

A similar result, i. e., breaking up chip, is obtained on an ordinary two-lip twist drill, by using a milling cutter of grooved type, which produces a drill as indicated in Fig. 3.

In drilling steel and steel castings, oil drills are of great value for fast drilling; 50 feet periphery speed being O. K., on Union drawn hub steel, for drills from ⅝" to 1½" diameter.

It is a good plan when drilling cast iron, brass, etc., to relieve all drills on periphery, leaving a very small amount of land. On copper this should be done, and, in addition, ground with considerable back taper for clearance. On two-lip drills, width of flute is generally made in the neighborhood of ¾ of diameter.

Reaming.

Reamers are generally made with an equal number of flutes for convenience in calipering. In milling the teeth, same are spaced in unequal number of degrees apart. This is a very important feature and is of great value in preventing chattering; as only once during a revolution are all teeth in duplicate positions.

Reamers are quite often made with spiral left-hand flutes. This also, to a certain extent, prevents chattering, and at the same time prevents drawing in. This form, however, is much more difficult to grind.

In order to ream uniform holes (as regards diameter) in a screw machine, it is necessary to always have an equal amount of stock for the reamer to remove. This can be best accomplished by using two reamers, one for roughing, and one for finishing. The roughing reamer should be preceded by a single pointed boring tool (or its equivalent), to insure a true hole. On thin work the finishing reamer should be of "rose form," so as to be self-supporting and prevent enlargement of hole by its weight.

For steel the reamers are ground straight; but, for cast iron, brass and copper, it sometimes becomes necessary to grind same slightly back tapering to prevent roughing up.

The teeth on reamers for steel and cast iron are generally on center and for brass, sometimes ahead of center.

On machine reaming, when possible to do so, the reamers are hung loose and allowed to follow the true or concentric hole made by a single-pointed boring tool.

Reamers passing entirely through work, are quite often made double, i. e., rough and finish combined, in which the first part is made a few thousandths smaller than the latter or finishing part.

When using one (sizing) reamer only, it is generally allowed to remove .005" to .007" of metal in diameter. On brass more is allowed than on steel or cast iron.

Square reamers (scrapers) are often used for fine finishing and especially on brass. Expansion reamers possess many desirable features; but there are few, if any, that can be adjusted and used for sizing, without grinding the cutting edges each time they are expanded, as unless perfectly fitted in as regards tapers, etc., the separate teeth do not expand equally.

As a matter of cost, however, this additional grinding amounts to but little in comparison with that of a new solid or shell reamer of large diameter, two and a fourth inch or more.

Number of Teeth Generally Milled in Reamers.

3-16 to ⅝" dia.	6 teeth.	2⅜ to 3" dia.	14 teeth.
⅝ to 1¼" dia.	8 "	3 to 4" dia.	16 "
1¼ to 1½" dia.	10 "	4 to 5" dia.	18 "
1½ to 2⅜" dia.	12 "		

A long hole is reamed straight by pulling rather than by pushing the reamer.

On babbitt, reamers of the usual form are used, with the exception that the point is ground tapering about ½" long, to a diameter equal to size generated by boring tool. This gives a smooth hole, free from lines, also prevents rings. Left-hand spiral flutes are recommended.

On taper reamers for screw machine use 2¼" per foot and upwards. They will cut much freer if made right-hand spiral flutes or angle, but on account of difficulty in grinding this is not often done.

For forming or curved reamers for projectile work, the above holds good. Reamers 1½ to 2¼" taper per foot should be fluted straight for finishers, the roughers made either of the step form or with a left hand spiral thread necked around. Reamers 0 to 1½" taper per foot are fluted left hand to prevent drawing in.

Roughing, taper and forming reamers are sometimes made for steel with an undercut, and also with right-hand spiral, and they remove the stock very rapidly.

Speeds for reaming should range from 20 to 30% less than turning and drilling speeds, as found under "Speeds." (See September, 1900, data sheet.)

On large taper reamers, with slight taper, it has been found good practice to make each tooth a different left-hand spiral and also "break up" the teeth as regards spacing

Rose reamers are quite often ground tapering, i. e., small at back, .003 to foot, and then are less liable to rough up the hole they are reaming, and give a straight hole very nearly correct in diameter.

Circular Forming Tools.

Good clearance for machine steel and cast-iron.

2" dia. cutter,	6" dia. work,	⅛"	above center,	front cut.
2" " "	4" " "	5-64"	" "	" "
2" " "	2" " "	1-32+"	" "	" "
3" " "	3" " "	1-16+"	" "	" "

Care must be taken on particular forms when forming cutters are not on center, that they are formed with this point taken into consideration.

Forming cutters of steps having great difference of diameter, and also with sharp corners, if made in sections, harden more easily and safely.

Circular threading tools for inside threading must be much smaller than the work, in practice about one-third.

Care should be exercised to use a correct angle of chaser.

Plain Forming Tools.

Clearance from 6½ to 10 degrees.

Rake: Machinery steel 8 to 13 degrees.

Rake: Tool steel, medium, 6 to 9 degrees.

Rake: Brass, none.

The clearance on tools for brass is quite often stoned off at cutting edge to prevent "biting in," (due to ease of cutting) and then chattering, due to great thickness of chip and consequent difficulty in severing. The "stoning off" also tends to act as a support for the cutter.

Facing.

For steel and cast iron, a cutter with from 6 to 12° rake cuts very freely. The clearance should be from 3½ to 10°, and when there is any tendency to chatter, the cutting edge should be stoned on clearance face sufficiently to prevent "biting in." On very broad work it sometimes becomes necessary to make cutters without any rake or angle, but allow scraping, to prevent chatter.

In practice it is found advantageous to place cutter ahead of center, exposing a longer cutting edge to work, giving thinner chip.

In multiple or inserted cutter heads, it is well to unevenly space the cutters as a precaution against chattering, also at different amounts ahead of center.

For all heavy facing, when possible to do so, use supporting or guiding plugs.

Use machines with large front bearings, and with chuck close to same, for good results.

Counterboring.

For cast iron and steel, counterbores are generally made with ten to sixteen degrees angle, i. e., spiral; for brass they are cut straight. Clearance is from five to ten degrees. On brass "stone" the clearance edge to prevent chattering.

Counterbores internally lubricated are recommended for steel, for use to a depth of ½ of the diameter or more.

Angle of clearance on all tools must be more than spiral generated by feed, at smallest diameter of cutting point plus sufficient to be readily forced in work (about 3°).

Shell counterbores having heavy duty to perform, if made with a taper hole, should have a taper of not less than ⅜" per foot, to prevent forcing on the arbor too tightly.

Thread Cutting.

Taps are usually made without clearance on top of teeth when necessary to back out of work, as chips have a tendency to wedge and tear the thread. It is often advantageous to relieve one side of teeth in one flute, and the opposite side in the next flute, and so on. Another method which is followed in the Echols tap is to remove every other thread entirely. The latter is especially good on taper threads, as threads may have clearance on top of teeth and also to the straight or plane part between teeth and thus act as a taper reamer. Either of the cleared taps acts well on copper. The strain on metal not being as severe, there is less tendency to wedge and tear, and there is also a chance for the metal to spring without adhering to a section of the tooth. These taps are made with an odd number of flutes.

Expansion or sizing taps are ofttimes indispensable on interchangeable work. It is beneficial to mill the flute at right angles to the pitch on taps for multiple threads. Taps used in screw machines should be allowed to adjust themselves concentric with the hole to be tapped, generally done by hanging the tap in a loose or wabble holder. For tapping coarse threads, two or more taps are frequently required. Short taps are better than long ones, where lead is particular, especially when the work or tap is carried on by a lead screw or equivalent method. In deep holes more chip room and less curl to chip is necessary than on shallow; also on brass and soft steel than on cast iron, so the form of milling cutter used for flutes is not always the same. On thin work more land is required to support the tap, than on thick. On the latter the general practice is to make the land ½ or less, than the space, unless on very fine threads or accurate sizing tools, when care must be taken that there is no tendency to rough up. Taps are usually cut on center for all work except brass and then a little above; in rare cases a little below. Tapping speeds vary with the pitch, but for standard threads it is generally 50 to 60% of turning speed.

The sizes of the twist drills to be used in boring holes to be reamed with pipe reamer, and threaded with pipe tap, are as follows:

Size Tap. Inches	Diameter Drill. Inches.
⅛	21-64
¼	29-64
⅜	19-32
½	23-32
¾	15-16
1	1 3-16
1¼	1 15-32
1½	1 23-32
2	2 3-16
2½	2 11-16
3	3 5-16

MISCELLANEOUS RECIPES FOR MACHINE SHOP USE.

Lubricants.

First—Lubricating liquid used for drilling, etc., by the Pope Company: 1 part oil to 9 parts water, and borax enough to cut the oil. About 1 pound borax to 1 gallon oil.

Second—Salts of tartar and lime water with 1 part oil to 10 parts water. '98.

Pickling.

Cast Iron—1 part oil of vitriol, 4 parts water; leave in 10 to 12 hours; rinse in clear hot water.

Forgings—1 part oil of vitriol, 25 parts hot water; takes about twenty minutes. Rinse in soda water. The bath is only good for a short time, say about thirty minutes, but possibly by a system of heating and adding ingredients, it could run indefinitely.

Finishing Slush.

Used in place of oil or soda for finishing work: 5 bars Babbitt soap, 5 lbs. soda ash, 10 oz. sal soda, ¼ lb. carbonate of ammonia, ¼ lb. carbonate of potash. Put into ¼ barrel water and boil eight hours. This can be reduced to one barrel of water.

* * *

HARDENING MILLING CUTTERS.

The following hints for hardening V-shaped milling cutters for milling tool steel are given in "Sparks:"

"Heat in gas furnace, fire or in lead. It is not so much a question of how, as of how hot, and whether evenly heated; and as to lead sticking to the work, if it is used, there should be little trouble if pure lead is used, with plenty of broken charcoal on top to prevent oxidation; but if there is still trouble it can be avoided by coating the work with salt before putting into the lead-heating bath. This is easily done by warming the work up to a blue and dipping in a strong solution of salt and water.

"The cutters may be cooled in clear water or brine, temperature depending upon the character of cutter, whether very delicate or not. With some heavy cutters, it might be ice cold, while in the case of some very thin, delicate cutters, it would be better to have the bath up to blood heat or even higher. It is simply a question of preventing cracking.

"Remove the cutters from the cooling bath as soon as the teeth have cooled sufficiently to harden and instantly immerse them in oil to remain there, if convenient, until cold. In this way the heat becomes equalized and prevents the antagonism of unequal strain which often produces cracks.

"The temper can be drawn in oil by the aid of the thermometer, or in the good old way of heating a rod to slip into the hole; an enlarged section or collar on the rod, to hold the heat, being an improvement on a plain rod."

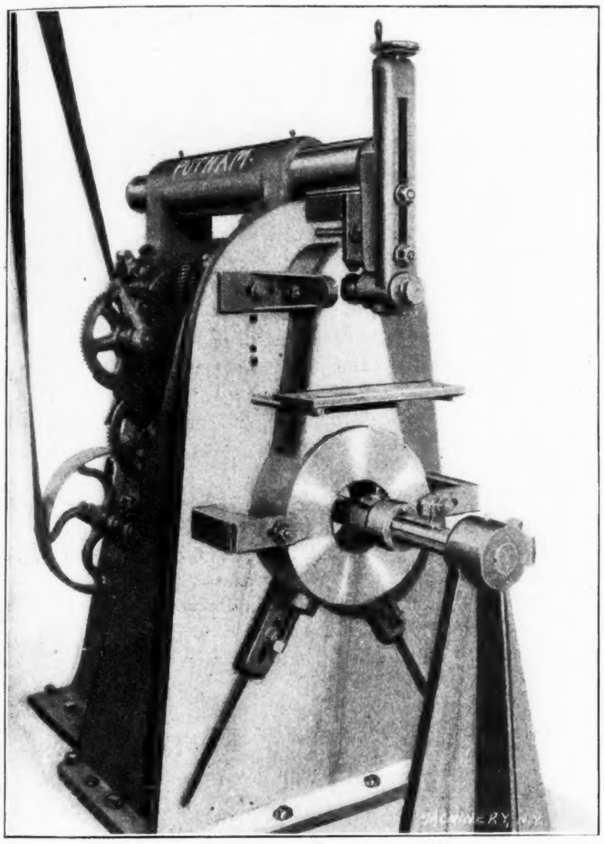
LETTERS UPON PRACTICAL SUBJECTS.

DESCRIPTION OF CRANK BORING MACHINE.

Editor MACHINERY:

The tool here shown is a new machine for boring taper holes, and illustrates the method used by the Putnam Machine Company in boring the holes in steam-engine cranks. The machine was designed by Mr. E. Newitt, foreman of the steam department, and built by the Putnam Machine Company.

It is so constructed that both holes in the crank are bored at the same time, and tapering. A standard taper of ⅛-inch to the foot is used on all their engine cranks. The larger bar for boring the hole for the shaft has an adjustment of ¼" in the taper. The tool is held in a turret which slides on ways having an adjustment from 0 to ¼" in the taper; and it is fed forward by a screw and traveling head which allows the tool to raise as it travels forward.



Boring both Holes in a Crank.

The slide is 24" long and is let into the bar and held at one end by a pin. The other end is raised and lowered by inserting a key in the micrometer screw, and when the proper adjustment is obtained it is held rigged by gib screws at the side. This arrangement is very convenient in repair work where cranks of different tapers are often found; as the taper of the "old piece" can be found by micrometer measurements, and the slide in the bar can be set to correspond. Then when the hole is bored, the taper will be found correct.

The smaller bar has a slide and traveling head, similar to the large one, except that it is not adjustable and only one taper can be obtained with it, which is in the opposite direction to the larger one.

The end of the bar is bored out to a Morse taper, and two sizes of bars, with slides planed on them, are used to accommodate the different sizes of crankpin holes. The outer end has a rigid support, which is shown in the figure. The difference in distance between centers is obtained by movable bushings in the top of the frame, through which the bar passes, and they can be moved to accommodate different sizes of cranks, and when located in the proper position are held rigidly in place by taper pins.

The feeds of both bars are obtained by screws and the well-known epicyclic gearing, and both have quick return and can be withdrawn completely through the work, allowing it to be conveniently lifted on and off the machine.

The manner of holding the work is plainly shown in the engraving. The machine is very heavy and powerful, and is a radical departure from the usual style of boring mills.

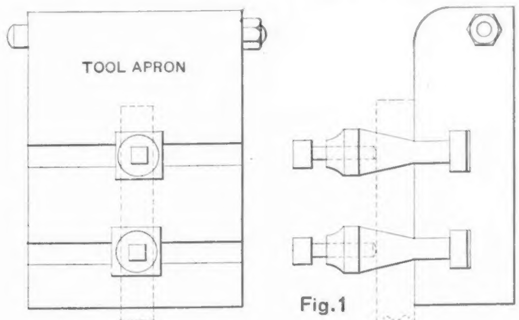
Fitchburg, Mass. H. W. E.

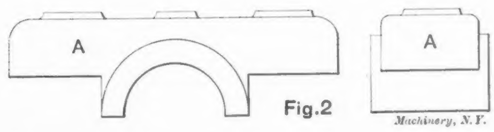
* * *

THE ADVANTAGES OF AN ENGLISH SHAPER TOOL APRON.

Editor MACHINERY:

I have always been surprised at the tool boxes put on American shapers. While I am obliged to give American shapers credit for being handy machines, every one I have yet seen has been handicapped with a tool box in which only one tool can be mounted. I am at present working an old English shaper, whose one good point is a large tool apron on which two tools can be mounted at a distance of 4" apart and as





near together as 1". So convenient do we find this arrangement that we have two tools working at least 8 hours out of the 9½ during which we work.

The accompanying sketches illustrate the different uses to which the two tools can be put. Of course I am aware that some of the jobs illustrated are properly milling machine jobs, especially the shaping of the 3" cap, but we have no milling machine, so adopted this scheme as the best substitute for gang milling cutters.

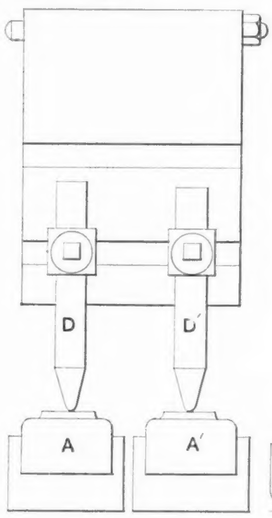


Fig. 3.

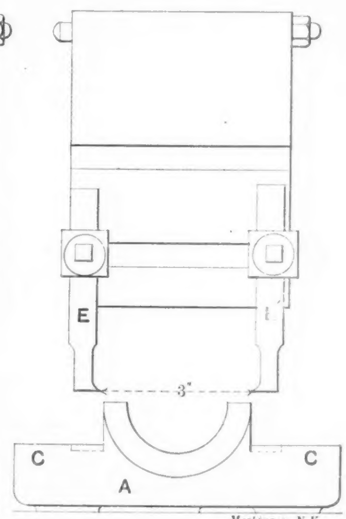


Fig. 4.

Fig. 1 shows the front and side views of the apron, with two tool-post slots in which two tool posts can be used, one above the other, as indicated. Instead of using them in this manner, we mount the two posts side by side in the lower slot at any distance apart to suit the work. Suppose the job in hand is a number of the caps shown at A, Fig. 2. The first operation is to machine the bosses on top. To do this we mount two caps in the vise and machine six bosses at the same time,

three on each cap, as shown in Fig 3 at A A'. The vise we have has a swiveling front jaw which allows it to "nip" each piece equally. After shaping all the bosses on the caps, we proceed to machine the faces in the same manner, two at once. We lay the bosses downward in the vise and with two tools, machine the ends of the lips in the same manner as the bosses were done. The next operation is to make the lips exactly 3" broad. This we do by clamping two square nose tools E E', with their inner cutting edges 3" apart and feeding down, as shown in Fig. 4. After this, the parts left at C C are machined with a single tool as the distance is too great to allow two tools to be held in the apron.

Another useful way to employ two tools, is to shape a casting to different heights as indicated by I, in Fig. 5. A gage similar to the work, is laid on the back jaw of the shaper vise and the tools F F' set from it and at the right distance apart. In this way the height B is gotten very closely and both faces are machined at once.

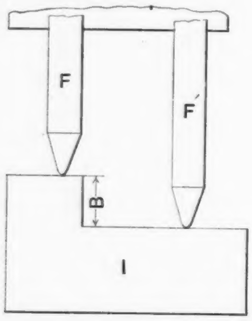


Fig. 5.

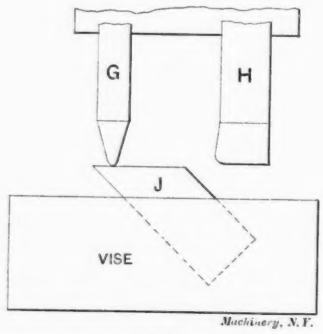


Fig. 6.

A regular job for this machine is the shaping of pieces like J, Fig. 6. When doing the top and bottom, I mount them in pairs as shown in the case of the caps, but in doing the angle side, I prefer to do them singly. Two tools, G and H, a rougher and finisher, are mounted at such a distance apart that when the rougher has just completed its cut, the finisher is ready for starting. The finishing tool is set so that it takes a very light chip. The rougher is carried across the work with the feed and the finisher with a coarse traverse. When the tools are once set, a large quantity of pieces can be done without altering the tools.

English Mechanic.

[Will some one arise and explain why this obviously excellent tool apron has not been more generally used on shaping machines? As presented by our correspondent, the advantages are many, with apparently no objectionable features. It greatly extends the field of usefulness of this already very useful machine tool. There is no valid reason why the tool apron could not be wider than that used by "English Mechanic," which additional width would materially increase the range of two tools. The evident effort of the designers of American shapers has been to confine the tool post in the center of the shaper arm in order to avoid side thrust, which, however, is present with the tool post in the center when the tool is set over at an angle. There is no reason for this fear of side thrust; it can be as easily taken care of as upward or downward thrust, which apparently gives the shaper designer no distress whatever.—Editor.]

* * *

SAW FILING.

Editor Machinery:

Of all the points made in the training of apprentices, there is nothing more important than the filing of saws. As there is not much said or written on this subject, what is said here may be appreciated and I shall be pleased if it opens the subject for discussion by those who have had more experience, as I am constantly studying and will appreciate any good suggestions.

Few mechanics have the opportunity of filing more saws than their own, unless they are quite successful. These few are often imposed upon by those who have made failures of first attempts, but who could file if they had a little instruction. This is the class that I wish to reach—those who want to learn. Very few are provided with a good saw vise and those vises which are on the market are all too short, so one is obliged to change the saw two or three times and thereby loses his position or angle.

It has been my pleasure recently to have made a saw vise to my own liking. It is 28 inches long, so that one side of a saw can be filed without moving it. It is provided with two hinged clamps for securing it firmly to a work bench. These hinged joints permit it to tilt to any degree from a vertical position. For cut-off saws, I like to lean the saw back 30 degrees from vertical, so that the file may be held in a horizontal position, as it is the easiest position to keep. File across the saw at 60 degrees out from the handle end and keep the upper surface of the file also in a horizontal position or level both ways. This will produce a tooth with a sharp cutting edge in front and square back, which is the strongest point a tooth can have with so sharp a cutting edge. Some will say that this is all very nice, but how can one who does not possess a degree protractor tilt the saw at an angle of 30 degrees. Lay the file down on one side and its two other sides are 30 degrees out of vertical. Set the bevel by this to test the angle that you wish to lean the saw back to. Notice that the cut on the file is at 60 degrees from its corner and you will have a guide to watch to keep the file at the proper angle to the cutting edge of the saw. Another great help is to put chalk marks on the bench underneath the saw all along so that you can keep in line with them. This is one of the important points to keep the teeth all alike.

For short back saws that are very fine, I like a vise on a swivel so that I can set the saw at 60 degrees from the front of the bench and file square at the bench, for this is an easy line to keep. While filing with the handle of the saw to the left and the handle of the file swung out to 60 degrees from the cutting edge of the saw, the cuts on top of the file are just parallel with the edge of the saw. Always commence at the right hand end and work towards the left. Crowd the file hardest against the large or longer teeth. Always joint the edge of the saw down until you touch the shortest teeth and file only enough to bring all back to points. Do not forget that both sides of the saw are to be filed in the same manner and do not file too much off the first side. Here you must use your own judgment.

To file a rip saw is very easy, comparfed with the cut-off saw, as the former is all filed from one side and held vertical in the vise. File the front of the tooth vertical and the file will do the rest, if you stop filing as soon as all the teeth are brought to points after jointing.

Band saws are usually filed the same as rip saws, but for fine scroll work I like them filed with about 10 degrees fleam or about one-third the fleam of a cut-off saw with the front or cutting edge vertical, or with no rake. Key-hole saws should be filed just this latter way, with set enough to clear easily.

In setting a saw, care should be taken that the teeth shall not be bent at their roots, as this will break the teeth out of a hard saw. The bend should be about one-third up from the root and should be a curve, rather than an angle. Most saw-sets have a sharp angle on their anvils which will produce a crack in a hard saw tooth and dent it if it is soft. For this reason I prefer a spring to a hammer set.

Edward T. Wires.

* * *

REGARDING ANTI-FRICTION BEARINGS.

Editor Machinery:

In your December issue, under head of chronology of the nineteenth century, year 1854, you state that the "anti-friction bearing mostly used on grindstones was patented by a Frenchman named Pomme." This, I would infer, means the familiar two wheel arrangement supporting the shaft at either end.

For the sake of history on the line of anti-friction bearings, I would call your attention to a drawing in the Department of Machinery of the National Museum, at Washington, D. C., which illustrates this form of bearing as having been designed in the year 1490, by Leonardo Da Vinci (Italian), who is also responsible, under the same date, according to the same authority, for the invention of the present wire spoke or suspension type wheel.

I may be in error in my reference regarding the Pomme invention, and, if in error, would be pleased to be set aright. If right, it may prevent the honor of the invention being given to one to whom it does not belong.

Regarding the French patents as to protection (?), you may be familiar with the case in which a few years ago an enterprising Parisian was allowed a patent on the attar of rose.

TYRO.

* * *

A UNIVERSAL INDICATOR.

Editor MACHINERY:

The accompanying cuts show the best all-around indicator I have ever seen. It can be used anywhere that an indicator possibly can be used and is neat and attractive in appearance. Figs. 1, 2, and 3 show three of the many applications to which it is adapted in testing work in machine shop practice.

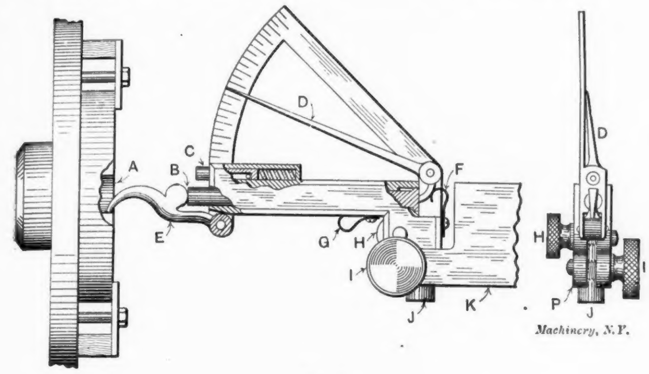


Fig. 1.

The indicator, as shown in the cuts, is held by a shank or holder in the lathe tool post. The holder is 1⅛" x ⅜" x 5" long. The holder is milled, drilled and slotted so as to clamp the spindle J after setting in the desired position. The knurled screw H is to clamp the spindle J solidly to the indicator,

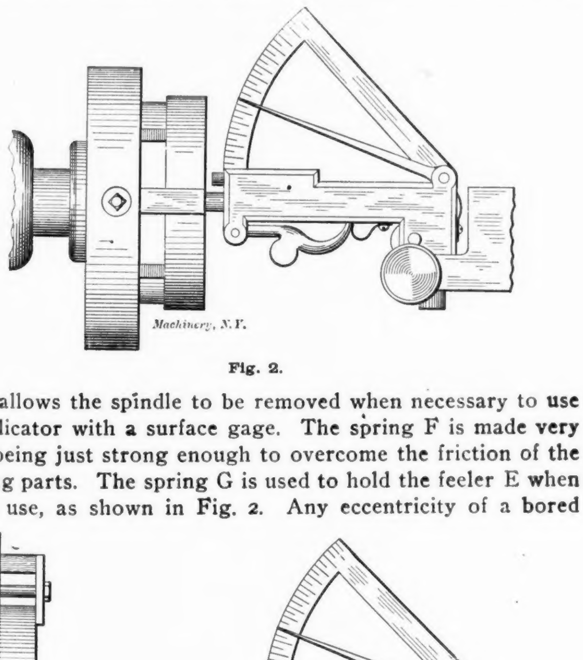


Fig. 2.

which allows the spindle to be removed when necessary to use the indicator with a surface gage. The spring F is made very light, being just strong enough to overcome the friction of the working parts. The spring G is used to hold the feeler E when not in use, as shown in Fig. 2. Any eccentricity of a bored

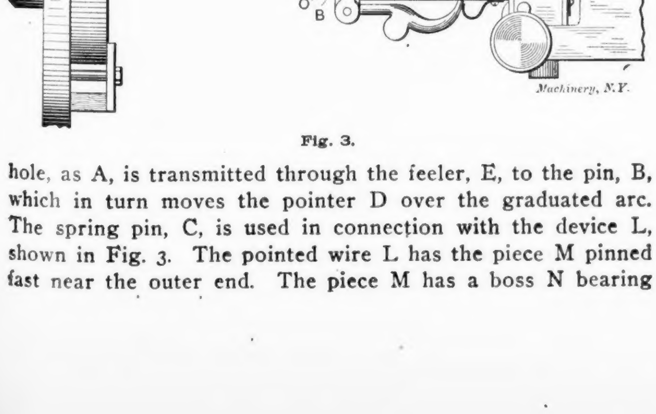


Fig. 3.

hole, as A, is transmitted through the feeler, E, to the pin, B, which in turn moves the pointer D over the graduated arc. The spring pin, C, is used in connection with the device L, shown in Fig. 3. The pointed wire L has the piece M pinned fast near the outer end. The piece M has a boss N bearing against the pin C and is made with a fork O, so that it straddles the pin B, as shown. The pressure of the spring pin C keeps the wire L in contact with the piece being chucked. It will readily be seen that any irregularity in movement of the center, in the piece being chucked, will be through the spindle B to the pointer D. When the work is trued so that the pointer does not move, it is pretty safe to assume that the piece is true enough.

GEORGE W. FREEMAN.

* * *

DIES FOR SQUARE TIN BOXES.

Editor MACHINERY:

The type of combination blanking and drawing die used in the manufacture of square tin boxes is similar to the die used for round work, the only difference being that the former requires more skill and experience to construct. With the combination die, more depends on the man and less on the tools than with the round die.

The dies described and illustrated herewith were made for

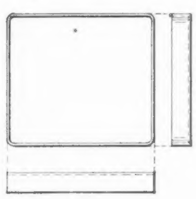


Fig. 1.

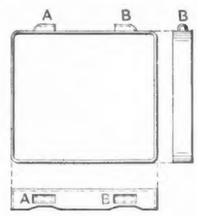


Fig. 2.

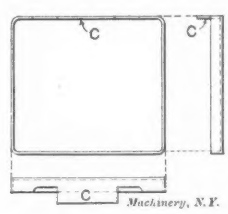


Fig. 3.

producing the box and cover shown in Figs. 1, 2 and 3. Fig. 1, the box, is the result of the first operation; Fig. 2, that of the second operation on the box, i. e., drawing and forming the parts A B for the hinges; and Fig. 3 shows the cover. The punch and die for producing the box, Fig. 1, are shown in Figs. 4 and 5 respectively. The various operations are as follows: First decide upon the exact size of the box, then make a pair of templets for the forming and drawing punch N and the die J, the difference in size being two thicknesses of metal. The templet for die J being the largest, care must be exercised to get the radius of all four corners exactly the same and the radius of the corners of the larger templets

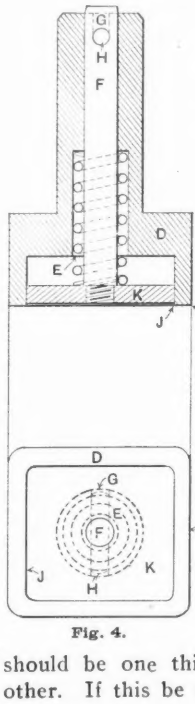


Fig. 4.

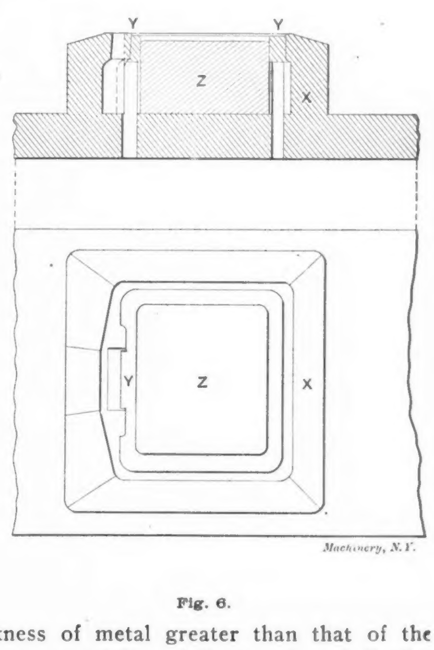


Fig. 6.

should be one thickness of metal greater than that of the other. If this be done accurately and the punch and die finished to the size of the templet there need be no fear of wrinkles in the work at the corners.

Now determine the exact size and shape of the blank. There are several rules for figuring this out, but the best and most reliable guide is experience. If, however, the diemaker has not had much experience, the best thing he can do is to finish the other parts first and leave the blanking for the last operation, when by making several blanks slightly different in size, he will easily find the right one. In our case, however, we first

found the size of the blank and made a templet for same. Then came the die, composed of a forging M, Fig. 5, of machine steel, with a face of tool steel. After being planed up it was set in a horizontal milling machine and milled out on the inside to templet, as shown, with a clearance in the bottom, the corners being finished with an end mill to exactly the same radius as the templet. It was then tapered to within 3-32 of the cutting edge, after which the inside of the die was draw-filed and given 1 degree clearance by filing. Next, it was carefully hardened and drawn and the face ground. The forming punch N, Fig. 5, was then made and finished to the exact size of these templets; but before locating this in the bottom it was necessary to make the blank holder ring O. This was done by milling out the inside to a nice fit around the punch N, and the outside to the size of the blanking die M, making sure that the inside and the outside were concentric. After the punch was hardened and drawn slightly and the face and back were ground perfectly flat and true, all the tight spots were eased up by grinding, until the forming punch N and the blank holder ring O would fit nicely without play within the die M. Two holes were drilled and tapped through the soft steel base L for the two flat-head screws P P. Next the hole for the spring barrel stud R was drilled and tapped as shown. Then the punch N was hardened and slightly drawn and located central within the blank holder and the blanking die by the two set screws P P, so that the blank holder could be easily removed and move up and down freely. Eight ¼" holes were then drilled through the base of L for eight blank holder pins Q, made of stub steel and finished square at each end to exactly the same length. We were now ready for the punch, Fig. 4.

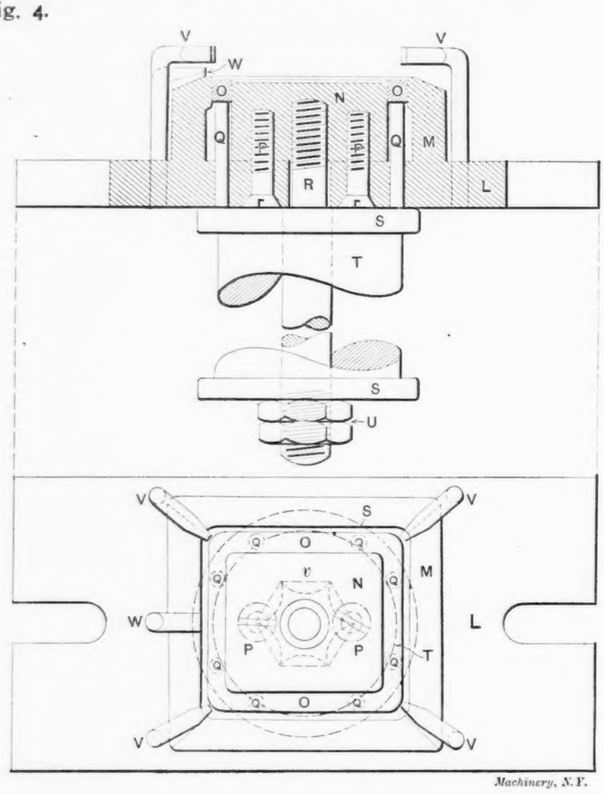


Fig. 5.

The forging was chucked in the lathe and faced at both ends, the stem or shank being finished to the size shown and a hole drilled and reamed through its entire length for the knockout stud F. The piece was then reversed and being held true by the shank, the hole was enlarged for the knockout spring E, after which it was put in the chuck of the horizontal milling machine and milled and finished around the outside to the size required. The drawing die J was finished to its templet two thicknesses of metal larger all over than the drawing punch N, Fig. 5, then hardened and drawn, with the back left soft. The knockout stud F, the plate K and the spiral spring E, were next made and the pin H let through the stud, fitting in the slot G. The face of the punch was ground and the parts assembled and the punch was then complete.

To finish the die, Fig. 5, we placed the four stripper pins V V V V and the gage pin W in the proper position; that is, the four stripper pins projecting far enough to allow the punch to descend without touching them and to strip the metal from it. The rubber spring barrel T, the stud R, the washers S S and the jam nuts were assembled and fastened to the die. The punch and die were then set up and the tension of the spring barrel T adjusted. As the punch descended the blank was punched and drawn up into the die J and the plate K, bottoming within the punch, formed the box, Fig. 1. As the punch rose the work was stripped by the spring E and the stock stripped from the punch by the pins V.

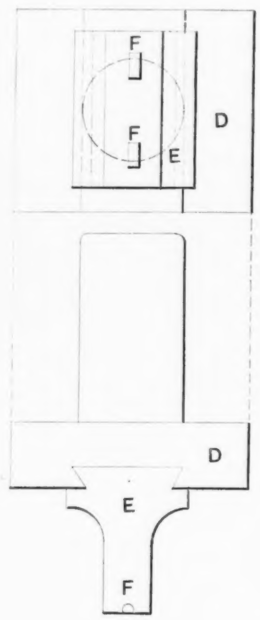


Fig. 7.

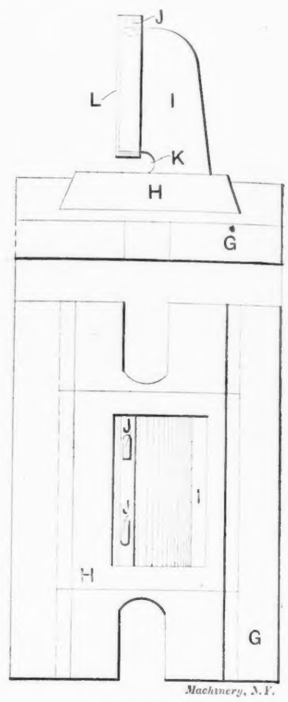


Fig. 8.

The punch and die for the cover shown in Fig. 2 are similar to those just described, the only difference being in the shape and size of the blank. An accurate templet, close work and skill are required to make a cover of this kind, one that will fit the box snugly all around. A die for this purpose is shown in Fig. 6. It will be seen that the only difference between this and the one previously described is in the shape of the cutting die X for producing the shape and size of the hinge C, Fig. 3. With this die it is also essential to get the radius of the corners perfectly correct.

The punch and die for drawing and forming the hinge for the box at A B, Fig. 2, are shown in Figs. 7 and 8, respectively and are very simple in design. D is the stem or punch holder, of cast iron; E the die, of tool steel, dovetailed and finished to the shape shown. Two slots, F F, were sunk in the face E with a small butt mill and finished in the corners with a graver. The punch was then hardened. The die, Fig. 8, is composed of the bolster of cast iron. The body of the die, I, is a casting fitting at H within the bolster G. A strip of tool steel finished, dovetailed and let into the face of I is the die proper. The face of L is worked away, leaving two projections or lugs at J J, which were two thicknesses of metal less in width than the slots F F in the punch and whose inside ends were left square and sharp so as to cut through the metal at this point. The front of the die was finished square so as to hold the box by the hand, in the position shown. As the punch descended, it cut through the metal and formed the hinges A B, Fig. 2.

To complete and finish the box, a piece of stiff wire 1½" long, bent in the center, is placed within the hinges A B, one end in each. The hinge of cover C, Fig. 3, is then placed around and a simple operation of the press rolls the hinge C around the wire and straightens the wire, finishing the box.

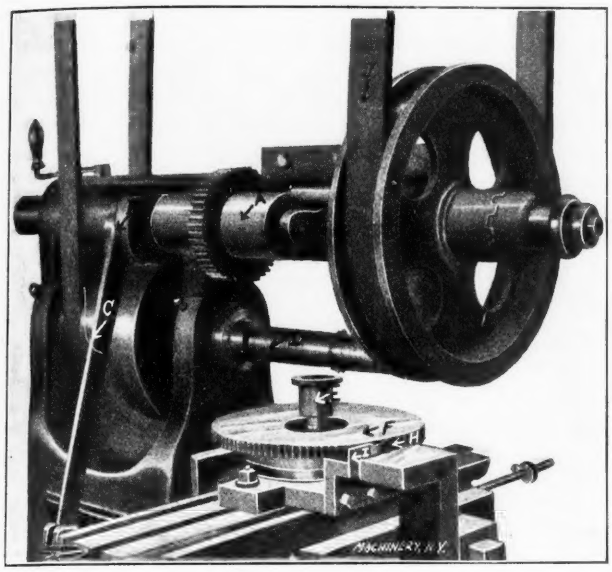
As most of the work is blanked and drawn from lithographed tin, close work and smooth finish are necessary on all the working points in order not to scratch the design and coloring of the tin.

Brooklyn, N. Y. JOSEPH VINCENT.

AUTOMATIC MILLING DEVICE.

Editor MACHINERY:

The following, showing how we cut fine teeth on the side of a disc may prove of interest to the readers of MACHINERY. We had a large number of these to cut, the same being used for adjusting the igniter cams on gas engines. The fixture was designed to use on an ordinary hand miller, operating the table with a lever as is usual. It consists of a saddle, carrying the pulley shown at the right; also a small gear which meshes with a larger gear on the second shaft which turns the crank shown at B, connecting with the operating lever by rod C. The disc shown at E is held on an expanding mandrel and is cut automatically. The dial F, with the desired number of



Milling Teeth on a Disc.

divisions, is acted upon by a stationary pawl fastened to bracket G. The ward plate I is adjustable so that the pawl will operate only on the right number of teeth of the dial. The belt J leads to the small pulley on the countershaft, which drives the spindle and arbor, D.

At every rotation of the crank B, the table is fed forward and back once. During the forward movement of the table a tooth is cut in the blank and during the backward stroke the pinion is spaced for the next tooth by the teeth in the dividing wheel coming in contact with the stationary pawl H.

The fixture will cut from 75 to 100 of these tooth adjustments a day, and we consider it a valuable acquisition to our list of tools.

Warren, Pa. A. A. AVERY.

* * *

COURSES AT PRATT INSTITUTE, BROOKLYN.

Editor MACHINERY:

I notice with interest, in the January issue of MACHINERY, the answers to the letter of inquiry which you sent out to the engineering colleges asking them on what conditions they could accept as students young men from machine shops and drawing-rooms who would like to take a technical course.

Many of these answers give a list of entrance requirements in mathematics and other subjects which put the regular courses entirely out of the reach of the majority of the young men whom you have in mind. I therefore think your readers may be interested to know what the Pratt Institute offers in its two-year courses in Applied Electricity, in Steam and in Machine Design—as we call the corresponding mechanical course. These are the only day courses which we offer in the Department of Science and Technology of the Institute, and we concentrate our whole strength and effort on making these fit the needs and requirements of the particular class of students to whom you appeal. These courses are not intended for those who wish to become expert professional engineers, but, rather, they are intended to give a systematic and thorough technical training to young men who wish to enter the drawing-rooms and shops of all those manufacturing industries in which machine construction plays an important part.

We make our requirements for admission as low as possible, requiring merely a good working knowledge of arithmetic and facility in writing correct English. We appreciate that the majority of the young men who are striving to advance themselves by obtaining technical training, have neither the means nor the time to spend on subjects which, while they may give excellent mental training and discipline, do not as well yield an immediate return by being of direct and tangible service to them in their life-work. Accordingly we make our tuition exceedingly low and our courses but two years in length, and fill these two years as full as possible of practical work which has direct bearing on the problems of machine design and machine construction, emphasizing the laboratory and the drawing board method and giving enough mathematics and theoretical work to put the above on a sound, logical basis.

DIRECTOR OF DEPARTMENT.

Pratt Institute, Brooklyn, N. Y.

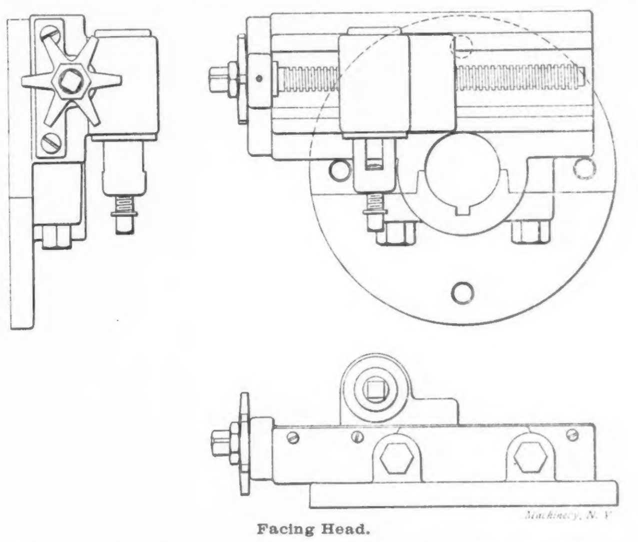
* * *

FACING HEAD FOR BORING MILLS.

Editor MACHINERY:

Several of the makers of boring mills use a face-plate facing head, and supply same with their machines; others make these heads to clamp upon the boring bar so that they can be used on either side of the casting, by turning the bar end for end without disturbing the casting. The writer has never seen one which could be used in either place, and feeling the advantage it would be to have a facing head so made, drew and built the one shown herewith.

It is provided with a large flange, so it can be bolted to the face plate of the mill, and the flange is split to clamp on the bar if desired. It follows, that on that class of boring mill in which the bar is rotated and fed through the head, it is possible to bore with the bar and face with this fixture at the same time.



Facing Head.

Frequently a rim or annulus to be finished occurs upon a casting which is too large to swing in the boring mill, and is ordinarily taken to the planer with a considerable loss of time, owing to the tool traveling over a square and consuming time sufficient to finish up a square surface with a side equal to the outside diameter of the ring. There is also the disadvantage of losing the time of the return stroke. Such a piece, and many of those jobs which are taken to the boring mill will offer legitimate employment for such a facing head.

Full figures are not given on the sketch, but it is made to scale, and shows the fixture as constructed for boring a mill with 2⅜" bar, capable of facing up to 16" in diameter, and taking an ordinary forged tool 1" x ½" in section.

New Britain, Conn. ROBT. S. BROWN.

* * *

TURNING LARGE WHEELS.

Editor MACHINERY:

Noticing in the November issue of your paper the article by "Nemo" on turning 20-foot wheels, I herewith submit another method, used by me a number of years ago.

We had some wheels of the above mentioned size to turn, but no lathe of over 30" swing with which to do this; so it was

decided to bore the hole for the shaft with a boring bar working vertically, the wheel lying on its side and the feed for the cut being applied from the lower end of the bar, as the wheels were to be used on steam engines. When the keyway was cut and the key duly fitted, with the shaft in place in the wheel, the shaft was put in its bearing. But previous to this the rim of a gear wheel about 12" diameter was attached to the arms of the wheel to be turned, and a piece of countershaft was fitted with a pinion to work in the gear. Pulleys were used, driven from a line shaft, and also two bearings. With all the bearings properly secured and the tool in the lathe rest set in position, the turning was begun and carried through successfully.

While this manner of doing the work is not as rapid as that used in our modern mills, where all the necessary tools are to be had, the wheels, when turned, were all true and the job was certainly a good and an inexpensive one.

Wilkinsburg, Pa. SUBSCRIBER.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

A correspondent wants to know of some way to prevent certain portions of a piece of work from receiving a coating of nickel when immersed in the usual way, at the same time giving the remainder a good plating.

21.—W. H. H.: We have in our shop a lathe which has no change gears for screw cutting, but which is arranged for it, having studs and a lead screw. Please give me instructions for calculating the gears for same to cut threads from 1 to 20 per inch, the lead screw having 4 threads per inch.

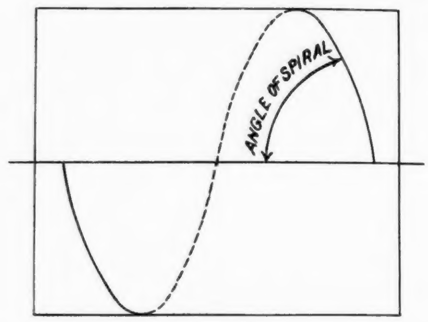
A.—You do not state whether the change gear stud has the same ratio of rotation as the spindle or not, a condition having a material effect on the sizes and pitch of the gears. Assuming, however, that the stud and spindle rotate at the same rate, which would be best for the range of threads required with the given lead screw, the ratios of the gears required to produce the various leads are calculated. The distance from the center of the change gear stud to the center of the lead screw must be taken into consideration, as it is the limiting condition to the size of the change gears. The combined sizes of any two required for any desired lead must not quite equal the center distance found. Thus, if the center distance was found to be 14", it would not be possible to use two change gears having a combined diameter of much over 13". The pitch will then need to be chosen which will give the required ratios, the largest possible teeth, and yet have the smallest gear having at least 12 teeth and preferably at least 16. The following table has been calculated on these conditions, using a diametral pitch of 8 teeth per inch. The smallest gear has 16 and the largest 80 teeth:

Threads per inch.	Ratio between Stud and Lead Screw.	Gears required.	
		On stud.	On lead screw.
1	4 to 1	64	16
2	2 " 1	64 or 32	32 or 16
3	4 " 3	64	48
4	1 " 1	48	48
5	4 " 5	32	40
6	2 " 3	32	48
7	4 " 7	32	56
8	1 " 2	16 or 32	32 or 64
9	4 " 9	32	72
10	2 " 5	16	40
11	4 " 11	16	44
12	1 " 3	16	48
13	4 " 13	16	52
14	2 " 7	16	56
15	4 " 15	16	60
16	1 " 4	16	64
17	4 " 17	16	68
18	2 " 9	16	72
19	4 " 19	16	76
20	1 " 5	16	80

It is, of course, obvious that with other pitches the numbers of teeth in the change gears could be varied, especially if made finer. If the change gear stud rotates at one-half the rate of the spindle, as is the case on many lathes, the effect is the same as though the lead screw had 8 threads per inch, and thus will change the ratios existing between the stud and lead screw necessary to produce any given lead. The same table of gears may be used, only using on the change gear stud in each case gears of twice the number of teeth. But as it would not be possible to use a 128-tooth gear on the stud with the given center distance, it would be necessary in the first instance to use a different combination, which would change the lead screw gear to a smaller denomination. Thus, for a lead of 1 pitch, 96 and 12-tooth gears would do, although the use of a 12-tooth gear should be avoided generally. For ½ pitch, or 2 threads per inch, use 64 and 16-tooth gears; for ¼ pitch, 32 and 16 or 64 and 32 would do; and so on.

22.—W. E. H.: How can I find the angle of spiral of a spiral gear to run at right angles with another spiral gear?

A.—To get the angle of a spiral gear, divide the circumference of the cylinder or spiral by the number of inches of spiral to one turn, and the quotient will be the tangent of the angle of spiral. When the angle of spiral and circumference are given, to find the pitch: Divide the circumference by the tangent of the angle, and the quotient will be the pitch of the spiral. When two spiral gears both have right hand teeth or



both have left hand teeth, the angle of the shafts will be equal to the sum of the angles of the spirals. Hence in this case the sum of the angles of the spirals must be 90°. To solve this problem first determine the angle of one of the gears by the rule and then subtract that angle from 90°, and the remainder will be the angle of the spiral of the other gear.

Answered by E. W. Roberts,

23.—J. M. M.: Please explain how it is possible for a gasoline engine to explode through the fuel valve when the engine does not receive a sufficient amount of gasoline, say when it is starting. This applies to either suction valves or those operated mechanically.

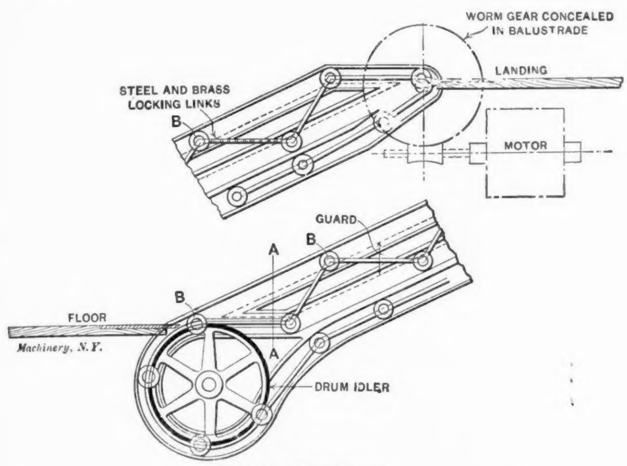
A.—This trouble, if it occurs when the valves are in good condition, may be traced to a slow burning charge. Ignition during the suction stroke may come from an incandescent part within the compression space, and often does. However, if the explosions occur when the engine is being started and the cylinder is cold, there could be no parts within the cylinder at a temperature sufficient to ignite the fresh mixture. A weak mixture does not burn so rapidly as a "full" one and the trouble may be caused by the presence of flame when the inlet valve opens. Two-cycle engines are especially subject to this trouble and they will frequently explode in the crank-case when running on a weak mixture. This trouble is not of so frequent occurrence on a four-cycle engine, and in case "back-firing" is encountered on an engine of this class, the valves should be carefully examined to see that they seat properly.

The January 15th number of STEAM ENGINEERING, published by the Industrial Press, contains several valuable contributed articles besides the usual departments of Correspondence, Questions and Answers, Electricity, and Education. J. M. Kent contributes an illustrated article, written in simple language, upon the theory of the injector, which is the best explanation of the subject that we have seen. Prof. C. H. Benjamin, supervising engineer for Cleveland, O., relates some of his experiences in smoke prevention in that city. The second installment appears of an article by C. L. Hubbard, upon proportioning steam pipe sizes for different conditions of heating or furnishing power. There is a list of recommended books upon steam and the steam engine, for those wishing books for reference or for home study, and finally there is a full description of a new and interesting form of distilling apparatus which has recently been put into operation and is entirely novel in its conception and operation.

ITEMS OF MECHANICAL INTEREST.

TRAVELING STAIRCASE.

The traveling staircase is destined to supply the need for transportation from one floor to another, where there are crowds of people to make the ascent. It has the advantage over the elevator that it is always moving in one direction and there is no time lost in loading and unloading passengers, nor in waiting for an elevator to return. Two of the elevated road stations in New York have been fitted with traveling staircases and excite considerable curiosity among those who are not familiar with the principle. In the accompanying sketch reproduced from the Railway Review, is shown a new type of staircase that has been brought out by the Link Belt Engineering Co. It is composed of steel links so arranged as to give flexibility in one direction, permitting passage around sprocket



Details of Staircase.

wheels or rollers at the top and bottom of the stairway, and perfect rigidity in the other direction, providing a secure and solid footing. This belt carries shafts with self oiling rollers at intervals. The framing provides two tracks, an upper one and a lower one. A stationary frog at the foot of the stairway switches alternate shafts into the upper and lower tracks in turn, thus deflecting the belt into alternate treads and risers. In ascending, the passenger simply steps on one of the treads after it has been formed, and at the top he is delivered safely, whether he remembers to step off or not, from the fact that the treads at the top rise higher than the landing, just as they pass over the top sprocket. They thus carry the passenger's feet over and onto the landing, and there is no danger of his tripping.

TWENTIETH CENTURY MARVEL.

We have received a circular from Mr. J. W. Fitch, Racine, Wis., who in turn received it from a firm in Chicago, known as the Prouty Motor Co. It may be that the Prouty motors which they manufacture are good machines, but the description in the circular is rather "hazy." It is stated that these motors are a modern discovery in science and mechanics that work a revolution in traction locomotion, and that it is no longer a question of whether the new system is a success, but a question of its wide influence upon modern commerce and civilization.

This is rather startling, and we are disappointed in not finding a lucid explanation of this potent factor in twentieth century civilization. The author of the circular explains that the motor is "designed to give the drivers a smooth revolving motion on the rails, there being none of the peculiar action of an oscillating piston and the connecting rods so fatal to high speed on the steam locomotive!" To ensure perfect perspicuity, he adds that "its drivers never pound, but hug the rails," and that "one locomotive can make a thousand mile run without change or taking fuel or water."

The uses to which this universal civilizer is to be applied are legion. The one thing to which it is by nature adapted, however, is coal haulage, so it is said, but here we must dissent. The inventor has evidently misjudged the ultimate effect of this marvelous conception and his ideal is far short of its far-reaching consequences. He vouches for the claim, substantiated, doubtless, by rigid experiment, that "the amount of load that a motor will haul is determined by the weight on the drivers and not by the horse-power!" Here then, is a newly discovered principle by which an infinitely heavy load can be hauled by simply piling an infinite quantity of pig iron on the driver axles. But if this be true, why haul coal? Here is where our promoter has fallen down. He has made a fatal blunder in attempting to capture coal operators with a machine that will eventually not only eliminate the demand for coal, but will in itself store energy, apparently to any desired amount. However, he adds a clincher for other clients, to the effect that "the unequaled economy in this motor is not discussable." Mr. Fitch, our informant, rightly adds that time and space will shortly be eliminated, when the Prouty gets into working order.

ABOUT THE METRIC SYSTEM.

In a recent number of the New York "Journal of Commerce," Henry Binsse, of the Newark Machine Tool Works, contributed an effective argument in favor of the English system of measurement as opposed to the metric. He says that to-day there is not a single workshop to be found using the meter as the base. It was found that in his place decimal points caused an enormous error and that even with the greatest care it was impossible to prevent this misplacement. The millimeter, therefore, has been adopted by common consent as the base of the system and for all workshop purposes measures of length are given in millimeters wherever the metric system is used. "On the other hand," he states, "we divide the inch into halves, quarters, eighths, sixteenths, thirty-seconds, sixty-fourths, tenths, hundredths and thousandths, and we use each one of these divisions according to circumstances. For instance, the sizes of rough iron vary by an eighth of an inch, sizes of steel by a sixteenth of an inch, pipe sizes are expressed in eighths or quarters, and so on. These sizes are just right for our daily needs; they have been adopted throughout the United States by various manufacturers, and they are so excellent that we find no difficulty in selling our goods, made to these standards, in the metric countries. The millimeter is about 1-25 of an inch, and you cannot express in millimeters the equivalent of our own in steel sizes, except with a long row of figures which cannot be memorized and which is most inconvenient to use. If you wish to satisfy yourself of the difficulties attending the use of the millimeter, get an iron and steel price list and try to express the sizes of that list in their equivalent millimeter dimensions."

Mr. Binnse argues that while the metric system was made legal in the United States in the sixties, it has made no progress in this country in shop work. Its adoption would not increase our chances of securing export trade, as shown by the experience of England, the greatest exporting country of the world. There are no less than sixteen screw-thread systems in the metric countries. The French army has its system, the French navy another system, and the various manufacturers of that country their own systems. The inch is used throughout Russia, England and all her colonies, and the United States, and these countries are more important than the nations which are said to use the metric system; but as a matter of fact, with the exception of Germany and France, it has been found impossible to enforce the use of the metric system beyond the department of government in most of the metric countries. For example, the metric system is supposed to be used in Mexico and South America, while in fact the mechanic and tradesman use something else.

THE WEAR OF WIRE ROPES.

The elaborate and painstaking experiments by Mr. Andrew S. Baggart, member of the British Institution of Civil Engineers, undertaken to obtain data for designing the hoisting ropes and blocks for building the Forth bridge, is the basis of the following estimate of the durability of wire rope when running over sheaves comparatively too small Theory based on these experiments points to a diameter of sheave, to prevent injury of the rope from bending, of about 400 times the diameter of the wire of which the rope is made, or about 150 times the diameter of a wire rope having twelve wires to a strand. This

is a very much larger diameter than can be used in practice; consequently the rope will be injured by bending over the ordinary hoisting sheaves.

The wear on a wire rope usually occurs from:

First. Fatigue of the metal from bending over sheaves relatively too small.

Second. Wear on the inside of the rope from the friction of the wires on one another.

Third. Wear on the outside wires.

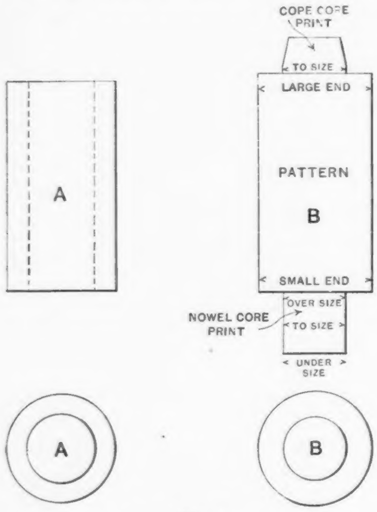


Fig. 1.

The first is illustrated in ropes running over ordinary pulley blocks. The second by the wear on ropes used in hoisting cages in mines. The third by the wear on street railway cables from slipping of the grips.

The most serious of these sources of destruction is the injury from the bending of the rope over the sheaves. The number of times that a rope can be bent over a sheave before breaking will vary with the diameter of the sheave. Experiments show that the probable life of a wire rope ½" in diameter, running over a sheave 16" in diameter, with a load 1-10 of the ultimate strength, would be about 160,000 bends in one direction. If the pulleys are so arranged that the rope is bent one way on one sheave and the opposite way on the other, the life of the rope will be about half of what it would be if bent one way only. From the above it will be seen that the number of sheaves over which the rope bends should be very few, and arranged to bend the rope one way only, the diameter being as large as circumstances will permit.

The injury by wearing of the wires where they cross each other, if on the inside of the rope, is very great if the rope runs without a lubricant. This can be reduced to a nominal amount by judicious oiling. The oil must be fluid enough to run into the interior where the wear takes place. Grease or tar is of no service whatever for this purpose. The use of a "sight feed" oil cup that can be adjusted to give a succession of drops while the rope is running and using a heavy oil, is to be recommended.—[Catalogue of C. W. Hunt Co.]

* * *

The long-pending negotiations leading to the consolidation of the Pratt & Whitney Co., Hartford, Conn., with the Niles Tool Works Co., were effected the latter part of January. The president of the new company is R. C. McKinney, president of the Niles Co. The Pratt & Whitney name will continue to be used for this department of the consolidation.

PATTERN-MAKING FOR APPRENTICES.

"HOBO."

A lesson in pattern-making for apprentice boys might prove a great help to many "kids," so I am going to illustrate a few of the simpler jobs that are apt to come to a boy in the earlier days of his apprenticeship. I will assume that the boy has some little knowledge of the use of bench tools and turning lathe, and will therefore start him off with Fig. 1.

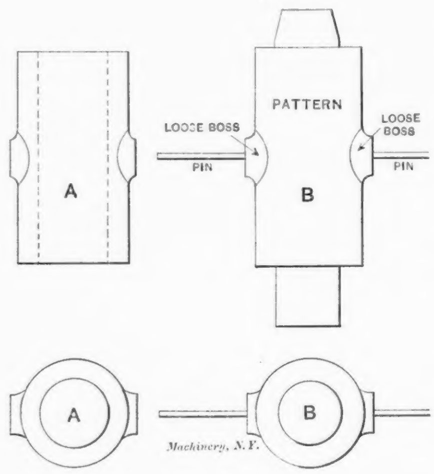


Fig. 2.

A, Fig. 1. is a plain bushing with a straight hole through it. A stock core is used and no core box is required. The pattern is turned from a solid piece of wood, to mold on end. The nowel or bottom print should be made a trifle under size at the extreme end and a trifle over size at the part nearest the pattern, and it should be exactly to size midway of its length. This insures the core entering the mold freely and binding a trifle as it is pushed down in its place. This same rule should also be followed in sizing the pattern; under size at the nowel end; over size at the cope, and exactly to size midway between the two ends.

The core print should be made straight for about 3-16 inch and then taper off with a fair taper. Where a stock core is used too much taper should not be given to cope prints, as the molder will probably have to file a straight core to fit them.

Fig. 2 is similar to Fig. 1 except that two bosses have been added to the bushing. This complicates the molding somewhat. It should be molded on end as in Fig. 1, but the bosses must be loose, so that the molder can pick them in after the pattern has been drawn from the sand. They should be fitted in position on the pattern and the pin holes drilled while they are in place.

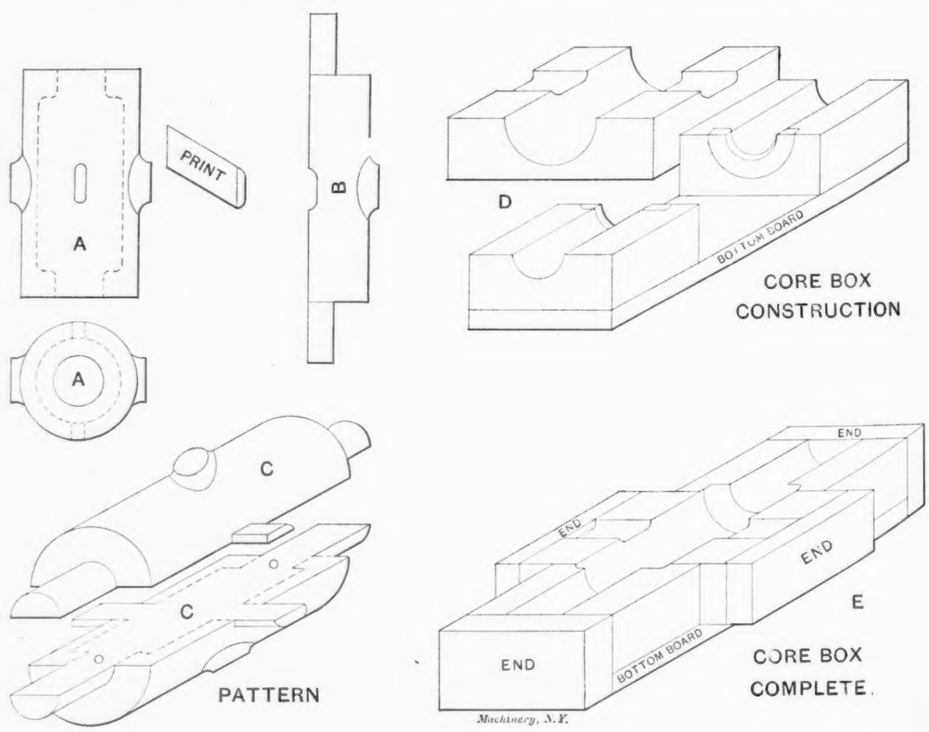


Fig. 3.

In A, Fig. 3, the bushing has a chambered core that cuts through the sides in two places, as shown. This necessitates a special half core box. In this case the pattern should be made in halves, as shown at C, Fig. 3. When patterns are made in halves, the dowels should always be put in the half intended for the cope. This allows the nowel half, which is always rammed up first, to be laid flat on a board. In this case it

makes no difference, as both halves are the same. The prints are turned parallel and the bosses are fastened permanently to the pattern. B, Fig. 3, shows how the prints, for guiding and supporting the core where it cuts through the sides, are fitted to the pattern. This print is in halves and the joint of the pattern is cut out to receive it. It should be fastened in place with screws, but no glue should be used if it is intended that the pattern stay straight.

The core box is easiest made in three pieces, as shown at D, Fig. 3, which are fastened to a bottom board with screws. The outline of the box is laid out after the pieces are screwed to the

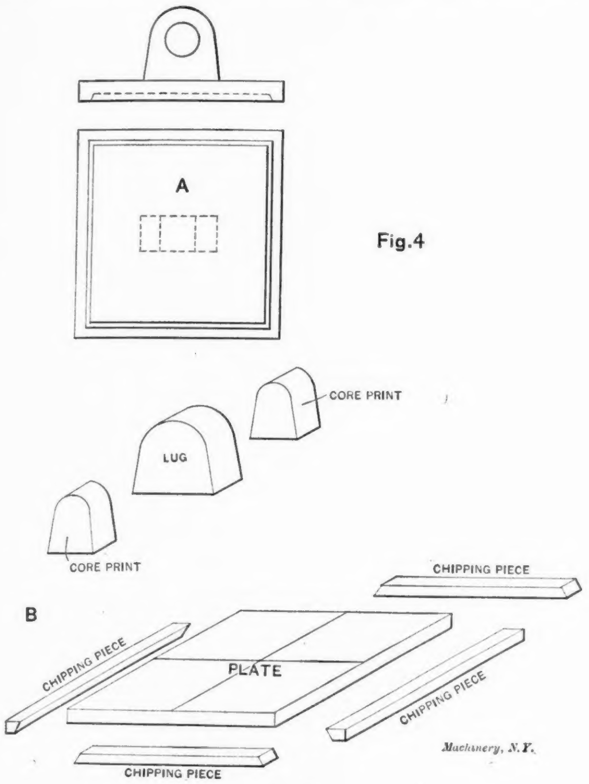
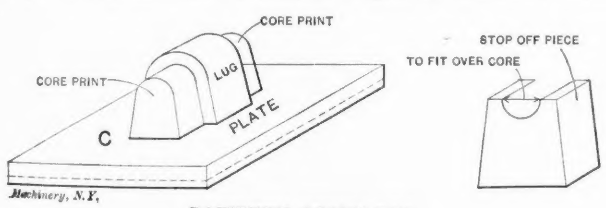


Fig. 4.

board. Each piece can then be removed separately, and the screws will guide them into their right places when they are refastened to the board. The chamber or larger part of the core box should be made short enough to allow the fillet to be carved out of the end pieces, as shown at D, Fig. 3.

At E, Fig. 3, is the core box complete. At A, Fig. 4, is a radical departure from the examples given above, consisting of a flat plate with chipping pieces on one side and a lug on the other. The lug side is molded down, and the hole in the lug is to be cored. B, Fig. 4. shows the pieces required to make this pattern. Care should be taken to make center lines on the plate, lug and core prints, as it greatly facilitates assem-



PATTERN COMPLETE

Fig. 5

bling. C, Fig. 5, shows these pieces assembled and the pattern completed. A stopping-off piece has also to be made. This is practically another lug, similar to the one on the pattern, only the round part is omitted, and it is cut to fit over the core, as shown. For convenience in handling it is best to make this stopping-off piece an inch or two longer than is absolutely necessary.

A straight round core makes the hole through the lug. This core rests on the round part of the core prints; the stopping-off piece drops in the mold, filling the impression made by the lug; the part of the core print above the core, which is stopped off, is then filled with sand, and the stopping-off piece removed.

NEW TOOLS OF THE MONTH.

Under this heading are listed the new machine and small tools that have been brought out during the preceding month. Manufacturers are requested to send brief descriptions of their new tools as they appear, for use in this column.

A foundry riddle is manufactured by H. S. Vrooman, 220 West 20th St., Chicago, in which the wire-cloth bottom is corrugated in concentric circles. This not only makes the bottom more rigid, but increases the screening surface and is said to increase the capacity of the riddle very appreciably.

The Howard Iron Works, Buffalo, N. Y., have brought out a new six-lever advance bolt header. It is designed for hot-forging hexagon heads on bolts from $\frac{1}{4}''$ to $\frac{1}{2}''$ diameter, and from 1 to 12″ long. It is of new design throughout and has an average capacity of from 6,000 to 9,000 bolts in 10 hours.

The Cincinnati Machine Tool Co. are applying an attachment to their upright drills by which the spindle can be reversed at the will of the operator, as in tapping. The device consists simply of placing an extra bevel gear on the spindle, above the usual gear through which the spindle is driven. Both this and the usual gear are driven by the same pinion and either one can be thrown into connection with the spindle by means of a clutch operated by a hand lever.

The Hill Tool Co., Anderson, Ind., are making a neat threading tool in which the cutter is in the form of a disc and can be ground almost indefinitely, or until used up, without changing the shape of the cutting edge. The cutter is ground accurately after being hardened, and is clamped to a drop-forged holder by means of a taper pin. The tool can be ground to give the exact clearance desired, and it can be used for either right or left-hand thread.

The Michigan Lubricator Co., 272 Baubien St., Detroit, are manufacturing a gas-engine cylinder lubricator designed by C. E. Sargent. The feature of the lubricator is a ball valve which nominally is closed by the pressure of a spring. This valve is located in the tube at the bottom of the lubricator and prevents the oil backing up through the passage during the high pressures in the cylinder. At each stroke of the piston, however, there is a diminution of the pressure sufficient to cause the valve to unseat, allowing the oil to escape into the cylinder. The quantity of oil that is fed is determined by a needle valve.

IMPROVED WRENCH HANDLE.

The Coes Wrench Co., Worcester, Mass., have adopted an improved form of construction for the handles of their wrenches, and three sizes of the new design, 12, 15 and 18-inch, are now ready. The handles are of steel, and the handle frame

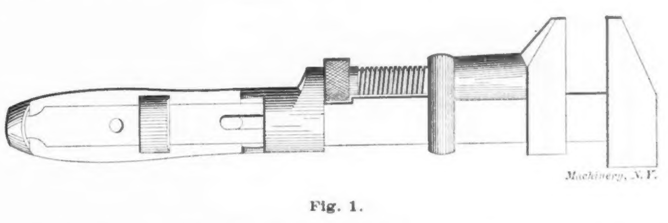


Fig. 1.

and ferrule are rigidly keyed to the bar, making practically one solid piece of metal. The ferrule and cup tip secure the wooden sides of the handle and keep them from splitting. An improved method of case hardening has also been adopted, giving a uniform and desirable degree of hardness.

YOKE RIVETER.

The Philadelphia Pneumatic Tool Co., Philadelphia, Pa., have brought out a new yoke riveter adapted to a wide range of structural and sheet metal work. It will drive rivets of any size up to $1\frac{1}{8}$ inches and may be used with any yoke from 10 inches to 10 feet or more. The features of the riveter are that it is positive in action, and that the whole action of the machine is under the control of one lever. The first movement of the lever causes the hammer cylinder to move out against the rivet; the next movement starts the hammer to work upon the rivet. When the rivet head is completed a reverse movement of the lever causes the hammer to stop working and

the cylinder to withdraw into its casing by air pressure. The advantage of this arrangement is that the cylinder may be moved out until the button set comes in contact with the hot rivet and held there while any necessary adjustments are made before starting the hammer to work. This will in many cases prevent spoiling the rivet. The machine may be used in any position with the certainty that the cylinder will remain in its casing until ready to drive a rivet.

DRILL PRESS ATTACHMENT.

The Hopkinson drill vise for sale by Manning, Maxwell & Moore, and illustrated herewith, is a useful attachment for the drill press. It is made with jaws 5" wide, 2" deep, and that will open 6½". A knee, adjustable upon the body of the vise, and held in place by pins as shown, contains the screw for setting up the movable jaw. This jaw clamps by means of a large bolt, partly upon the body of the vise and partly upon the knee. It therefore holds the latter securely in position, and at the same time is rigidly supported and will hold very heavy work. The stop pins are hardened and cannot fall out, and there is a hardened surface on the jaw for the adjusting screw to bear against.

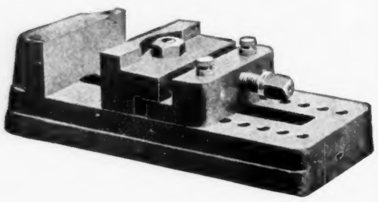


Fig. 2.

NEAT OIL-HOLE COVER.

A self-closing oil-hole cover and cup, with rotary head, has been brought out by W. W. and C. F. Tucker, 302 Asylum Street, Hartford, Conn. The cup can be screwed down to place and the port turned in any direction desired to introduce the oil. The port being placed on the side, is not liable to catch dust. The port is closed by a ball which is pressed against the opening by a spring. The outer portion of the ball is hollowed out to receive the end of the oil can, which pushes the ball back, allowing the insertion of the point of the can. The size of the opening in the base can be made small to allow a slow feed of the oil, if desired. These cups are made in plain and nickel finish and in several sizes.

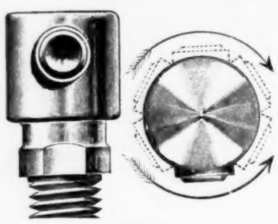


Fig. 3.

OIL CUPS.

A simple oil cup designed for use on locomotive guides was illustrated in a late issue of the "American Engineer," from which the following illustration is taken. The cup appears to be very well adapted for general machinery as well as locomotives, particularly grinding machinery. It consists of but two parts, a body and a cover, which latter completely excludes

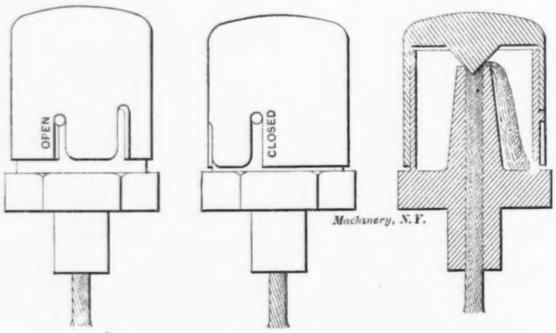


Fig. 4.

dust. When the cup is feeding, the cover is raised off the wick and seat, resting on the pin in the short slot, as shown at the left. To stop the flow of oil the cover is changed so that the pin will be in the long slot, the cover falling by gravity, and resting on the wick and seat. The cup is patented and is being introduced by J. S. Coffin, Franklin, Pa.

IMPROVEMENT FOR TWIST DRILL GRINDER.

L. S. Heald & Son, Barre, Mass., manufactuers of twist drill grinders, have adopted a new design of bearings for their grinders which possesses novel features. As will be seen in the cut, the arbor is turned with a sufficiently steep taper at the end which carries the principal wheel. It is then turned straight for the fit of the driving pulley and then smaller for the other end, on which is a snugly fitted sleeve with the outside turned of the same taper and proportions as the front journal. On the outer end of this sleeve is carried a thin and light emery wheel, if desired, as shown in the illustration. The object of this arrangement is to provide a means for taking up both the wear of the journals and bearings and the end thrust. The machine was formerly constructed with one long, straight taper bearing, the wheel being on one end of the arbor and the pulley on the other. To adjust for wear the arbor was drawn

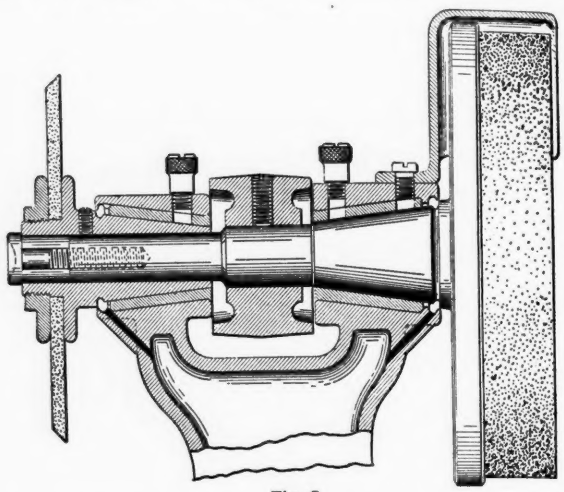


Fig. 5

into the bearings. It was found that the ends would wear much faster than the center of the bearing, and when adjusting the arbor would be too tight at the center. In the new design the adjusting screw at the left-hand end of the arbor can be made to slide the bushing upon the arbor, drawing the two together, and taking up the wear of both boxes simultaneously. The bushing is held in place by the set-screw shown on top.

Another feature of the machine, not shown, is the mounting of the emery wheel. The wheel consists of a ring and it is threaded into the wheel chuck by means of a ring of soft metal. This provides a safety arrangement and the whole wheel may be used up in service without interference by any metal web or other part.

BENCH DRILL.

The Geo. Burnham Co., 21 Hermon St., Worcester, Mass., have a new style and size of bench drill, of which we show an illustration. It is arranged with a three-step cone on the

Fig. 6.

spindle, belting to a cone of the same size on the base. The change from one step to another is made easily by throwing up or down the lever that holds the two-flanged idler pulleys.

The tight and loose pulleys are to be belted directly from the main line of shafting, making a three-speed self-contained drill. It has a large drilling capacity for a tool of this class, drilling holes ½" in diameter or under.

IMPROVEMENT IN HOLDING DIES.

The following is a description of a handy way of holding dies in punching machines. Fig. 7 shows a full size die, as made for this purpose, with a bevel shoulder on its base. Fig. 8 represents the manner of holding the die to the bed of the machine.

Fig. 7.

This is done with a screw coupling, having a bevel shoulder corresponding to the bevel shoulder of the die, and which holds the die firmly in its seat and always in the center.

When dies are made in this way and used in connection with punches of the same construction and held with screw coup-

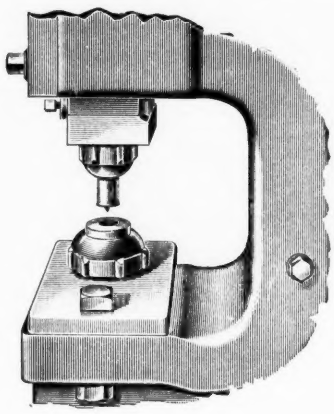


Fig. 8.

lings, as in Fig. 8, both the punch and the die will always be in line, a very essential condition when punching iron and steel.

This arrangement will also be very handy when changing punches and dies, as it will save considerable time. These dies and punches are manufactured by I. P. Richards, Providence, R. I.

PORTABLE ROTARY PLANER.

The Newton Machine Tool Works, Philadelphia, Pa., have made a new departure in the design of rotary metal planers.

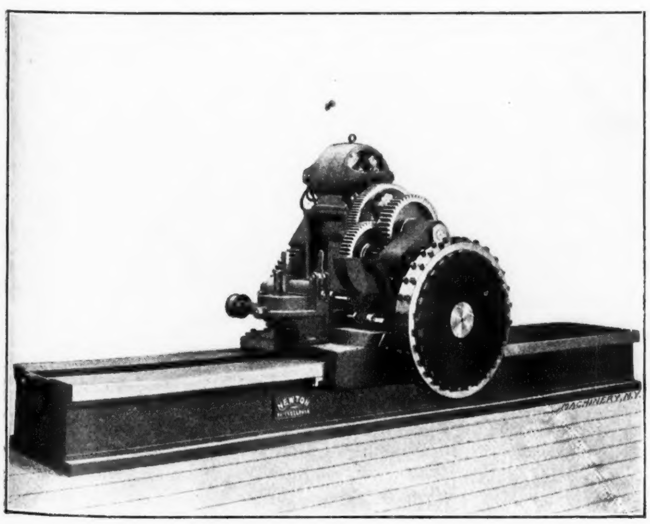


Fig. 9.

The accompanying illustration shows a portable machine for machining large castings after they are clamped in position on the bed plate. The motor for driving the machine is placed on top of the spindle saddle. The cutter head is 36 inches in diameter and is driven from the motor through a train of spur gearing, the illustration showing the machine with the gear cover removed. The motor also operates the feed, and by disengaging the feed worm and operating the clutches on the bevel gearing encased in the bracket shown on the end, the head can be quickly operated in either direction without reversing the motor. The entire driving mechanism is carried on an extra saddle which is gibbed to the bottom saddle, allowing a fine adjustment for convenience in setting the head after the base is clamped. With this arrangement of drive, there is no long driving shaft, and where extreme length of base is required, a rack can be used in place of a screw for the feed. This machine was built for the E. P. Allis Company, of Milwaukee.

DIRECT DRIVEN BLANKING PRESS.

The accompanying illustration, Fig. 10, is of a heavy punch driven directly by an independent electric motor. It shows one of the applications made by the Bullock Electric Mfg. Co., Cincinnati, O., who make a specialty of electric driving for machine tools. It should be noted that the motor occupies no more room than the driving pulley of a belt driven machine, is

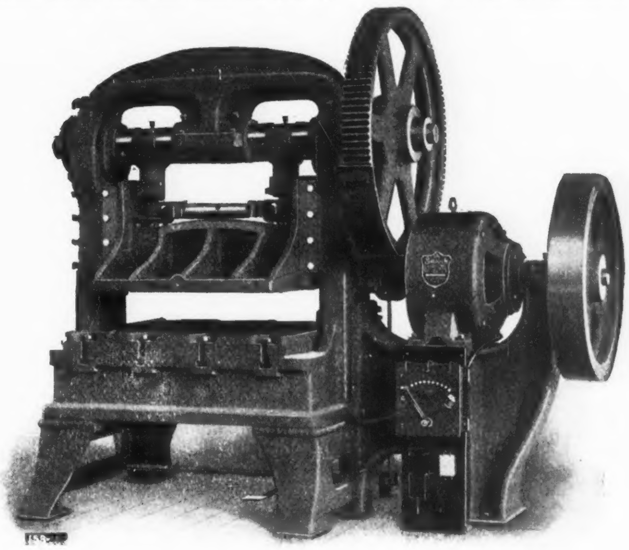


Fig. 10.

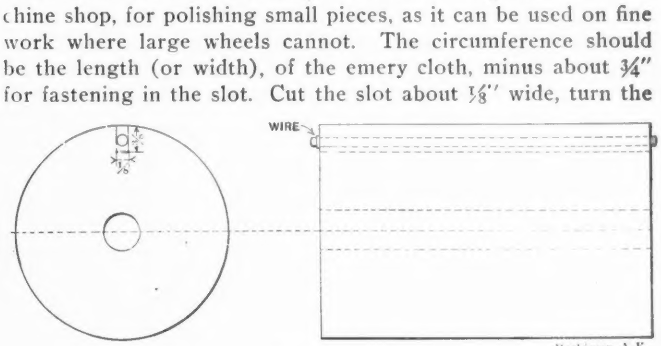
series wound, operated at 240 revolutions per minute, and at this speed develops 4 horse-power. The main switch, fuse box and rheostat, as shown in the cut, are mounted upon a board fastened to the motor support.

The machine is compact and powerful, and being electrically equipped, may be set upon the shop floor without regard to line shafting, a feature that makes it possible to greatly economize in floor space.

* * *

BUFFING ROLL FOR EMERY CLOTH.

Alf. E. Carter, Providence, R. I., says: "The buffing roll here shown will be found very useful and handy around a machine shop, for polishing small pieces, as it can be used on fine work where large wheels cannot. The circumference should be the length (or width), of the emery cloth, minus about ¾" for fastening in the slot. Cut the slot about ⅛" wide, turn the



Buffing Roll.

ends of cloth in, then drive in a piece of wire, which will draw the cloth tight on the roll. The hole can be made to fit on the screw of the emery grinder (just push on tight), or on an arbor for a speed lathe. The advantages are: It uses all the emery cloth, can be used on curved pieces, and when worn, the cloth can be quickly renewed.

FRESH FROM THE PRESS.

The Complete Cost-Keeper, by Horace L. Arnold. Published by the Engineering Magazine Press, New York. 408 8-vo pages. Price, $5. Illustrated.

This book contains twelve chapters and is made up almost entirely of descriptions of cost-keeping systems, which are in successful use in a number of manufacturing plants. Much of the mattter has been reprinted from articles, by the author and others, published in the "Engineering Magazine." The book is probably the most complete treatise on shop cost-keeping that has been published. Among the chapter headings are: A Production Order System; A Sample System for Duplicate Work, adapted to a small establishment; A General System for a Medium Size Plant, including repairs as well as manufacturing; A Complete System for a General Iron Works, covering all departments, and An Elaborate System for a Highly Organized Establishment. There is a chapter upon mechanical aids to accounting, which includes descriptions of time clocks, computing machines, etc. The author also presents an argument showing the advantages of account keeping by means of cards instead of books. This is a volume that it will pay any superintendent or manager to study, and in fact, it is a book that every such person should own, since the numerous practical features that have been adopted in various works cannot fail to afford suggestions to even the most experienced manager.

A Text Book on the Mechanics of Materials, by Mansfield Merriman, professor of civil engineering, Lehigh University. Published by John Wiley & Sons, New York. 368 8-vo pages, illustrated. Ninth edition, revised and enlarged. Price, $4.00.

Professor Merriman has the reputation of being not only scholarly, but of presenting engineering subjects in a very clear and lucid manner. His text book on mechanics is a treatise upon the strength of materials, including beams, columns, shafts; riveted joints, pipes, etc. There is no attempt to present in extended form the results of tests of materials. The book is devoted to the theory of the subject and an explanation of the methods of calculating the various problems that arise in practice. Numerous examples to be worked out by the student are given throughout the book. The calculus is used only to a limited extent and is in such form that a person can easily apply the principles of the subject in the solution of examples without any knowledge whatever of the higher mathematics. Interspersed throughout the text are tables giving average values for the strength of various substances which answer the purpose for most work. For exceptional problems engineer will have to consult books containing more detailed accounts of tests.

As illustrating the simplicity of the treatment, continuous beams are treated analytically without the use of higher mathematics. The later editions of the work have contained information upon problems not ordinarily included in similar text books. For example, stresses in guns and hoop shrinkage are considered, combined stresses and the theory of elasticity, and numerous special problems such as a triple crank pin, hollow shafts, shaft couplings, are treated. In the ninth or last edition errors have been eliminated so far as possible, new matter upon eccentric loads, tests under impact, and information concerning the international association for testing materials have been added in order to keep the book abreast of modern practice.

Pumping Machinery, by Henry Davey. Published by Charles Griffin & Co., Ltd., who are represented by J. B. Lippincott, Philadelphia. 295 8-vo pages, illustrated. Price, $6.

This book treats of the subject of pumping machinery from an English standpoint and would be valuable to an American engineer mainly through the information it would afford upon English practice. The pumping plants described differ quite essentially from those found in this country. The question of mine pumping is taken up at length, the Corliss engine receiving full treatment, and the various modern types of pumps such as are now found in English practice also have consideration. The chapter upon water works engines is very brief. Pumping-engine economy is discussed, with quotations of engine trials, and the following miscellaneous subjects have a separate chapter; Hydraulic Transmission of Power; Valve Gears; Centrifugal Pumps; Hydraulic Rams. The subject is considered mainly from a practical standpoint, subjects such as pit work and shaft sinking being discussed.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Northern Engineering Works, Detroit, Mich. Catalogue of air hoists and pneumatic uplifting apparatus, including traveling cranes, elevators, etc.

J. M. Westmacott, Providence, R. I. Circulars of gas burners. These are made in styles adapted to hardening and annealing tools, wire, and various small parts of machinery.

New Era Iron Works, Dayton, O. Illustrated catalogue of gas and gasoline engines. The details of the construction of the engine are shown by small illustrations, besides the usual descriptive matter and illustrations of the different styles and sizes of the engines.

Pittsburg Machine Tool Co., Allegheny, Pa. Catalogue of lathes ranging from 26" swing to 60" swing. These lathes are heavy and substantial in design.

Automatic Machine Co., Greenfield, Mass. Illustrated catalogue of speed lathes, cutter grinders and small tools and attachments for lathe work.

Fox Machine Co., Grand Rapids, Mich. Illustrated catalogue of single and multiple spindle sensitive drills, milling machines both horizontal and vertical, shapers and pipe cutters. These tools have been brought out primarily for use in their own shops and after trial there have been placed on the market.

Perkins Machine Co., Boston, Mass. Catalogue of shapers, power presses, drop hammers, punches and the Gillespie hydraulic governor. The presses and metal-working machinery are made in large and small sizes. We note that one of the tools listed is a compressed air drop hammer, weighing 64,000 pounds.

Fay & Scott, Dexter, Maine. Illustrated catalogue of machine tools and pattern makers' lathes. The tools illustrated and described include engine lathes, turret lathes, and a lathe for automatically drilling spindles. Several novel forms of turrets for lathe carriages are shown and also a number of special appliances such as planer chucks, and shaper centers. The pattern lathes cover a wide range.

L. W. Pond Machine Co., Worcester, Mass. Catalogue of planers, pulley-turning and boring machines. The planers illustrated are a complete new line made from new patterns. They are of the "straight-line" type, that is, all the lines of frames of the planers are straight lines, no curves being used. This gives the machine a novel and striking appearance. On the pulley machines the pulley is mounted on a vertical shaft and tools operate on opposite sides, sliding on vertical ways.

MANUFACTURERS' NOTES.

The Badger Brass Mfg. Co., Kenosha, Wis., have just installed a No. 1 special Cross oil filter purchased from the Burt Mfg. Co., Akron, O.

The New Era Iron Works Co., Dayton, O., report that they have recently bought and equipped a new plant and that in consequence their capacity has been doubled.

Mr. Jos. H. Williamson, manager of the Viennot Advertising Agency, Philadelphia, has removed his New York office from 127 Duane Street to Room 719, Temple Court, where, he announces, he will be pleased to meet his clients and friends.

We are informed that an order has just been closed with the Sprague Electric Co., 257 West 34th Street, New York, for 20 horse-power motors of the slow-speed direct-connected type, to operate the new plant of the Delaware Button Co., Wilmington, Del.

Mr. Thomas Fawcus, formerly superintendent of the R. D. Nuttall Co., has resigned his position and has entered business on his own account under the firm name of the Fawcus Machine Co. This company will manufacture gears, special machinery and will engage in general machine work.

We have received word that after Jan. 1st the Q. & C. Co. and the Railroad Supply Co. would be operated as one company under the name of the Railroad Supply Co., with D. S. Wegg as chairman of the Board, and C. F. Quincy as president. The general offices of the company will be Bedford Building, Chicago, and the New York office, 106 Liberty Street.

It is rumored that the Newton Machine Tool Works, 24th and Vine Streets, Philadelphia, Pa., expect to build an entire new works for large types of machine tools, steam hammers and hydraulic machinery. C. C. Newton will remain president and hold controlling interest, and the management will not be changed.

We are informed that the contract for the complete lighting plant for the city of Detroit, Mich., has been let to the Northern Electrical Mfg. Co., Madison, Wis., for $35,865. The apparatus called for is to be of Northern and Stanley make. When finished, the Detroit lighting plant will be, we are told, one of the most complete and modern municipal installations in the country.

The Cleveland Punch and Shear Works Co., Cleveland, O., report quite a large number of orders. Among them is one from the Carnegie Steel Co., Pittsburg, Pa., for one of their 50" rotary planers, one special "I" beam punch, one 16' radial drill, and one bending and straightening machine to McMath & Colburn, Walkerville, Ont., and a number of other orders.

The Storey General Electric Co., formerly the Storey Motor and Tool Co., have removed their offices and factory from Trenton, N. J., to a larger and newly-equipped factory at Sussex, Third and Bergen Streets, Harrison, N. J., where they will continue on a larger scale the manufacture of the Storey motors and will also take up a number of additional lines. Mr. I. E. Storey is president of the new concern, and Mr. Theo. W. Myers is treasurer.